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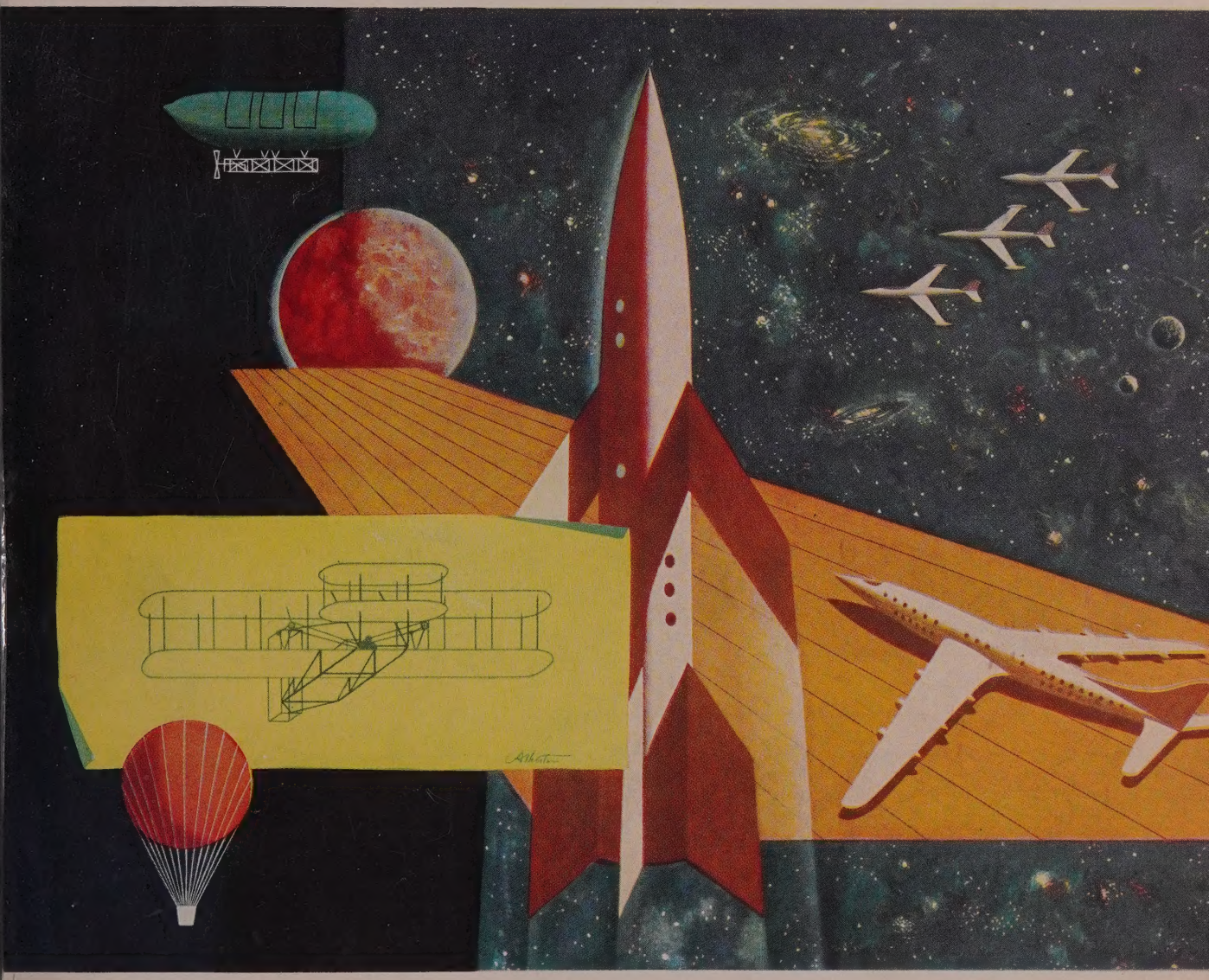
ILLINOIS TECHNOGRAPH



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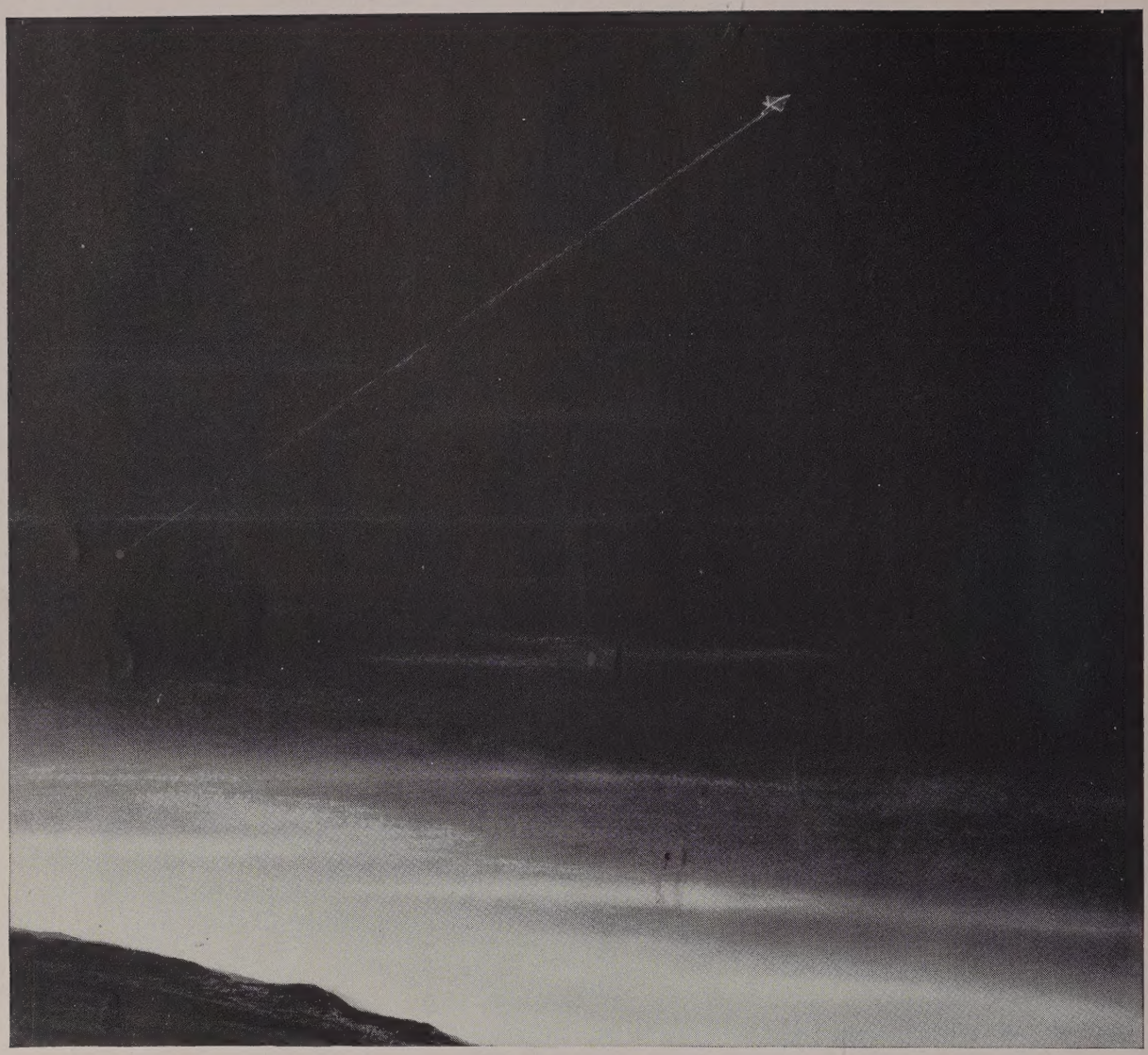

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THE ILLINOIS TECHNOGRAPH

volume 68 **number 7**

contents:

Education ---- 9
TV at the Chicago Professional Colleges ---- 12
TV for All ---- 15
Shell Oil Company ---- 18
Dean Harvey H. Jordan ---- 26
Richard Rider ---- 26
What is Light? ---- 28
TV at the U. of I. ---- 30
TV and the Water Pressure ---- 33
A Message from Herbert Hoover ---- 39
The Television Camera ---- 44
S.A.E. Debate ---- 46
Oil in the Basin ---- 50
I Speak My Piece ---- 52
The Gullible Public and TV ---- 54
"We Take What We Can Get" ---- 56
1953 Engineering Open House ---- 60
Festival of Contemporary Arts ---- 64
Technocracks ---- 68
Editorial ---- 72

our cover

The rise of aviation is illustrated in the drawing prepared for the National City Bank of New York who furnished the four color plates.

our frontispiece

The world's largest autotransformer furnishes power for the atomic energy plant now being constructed at Paducah, Kentucky. The transformer was built by the General Electric Company at it's Pittsfield, Massachusetts, plant for the Illinois Power Company. (Cut courtesy General Electric Company)

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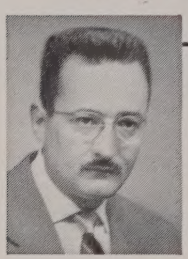
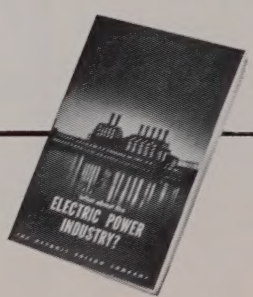


Don Blodgett set his sights on advancement following graduation from the University of Wisconsin with a BSEE. Five years of Army service delayed his start with Detroit Edison until 1946. Since then his career has been filled with challenge and responsibility. Today finds Don a Senior Engineer directing the work of our high-power laboratory, which proves new equipment design and construction before integration in our Electrical System. Career planning in Don's case still goes on for his engineering future is bright at Detroit Edison.



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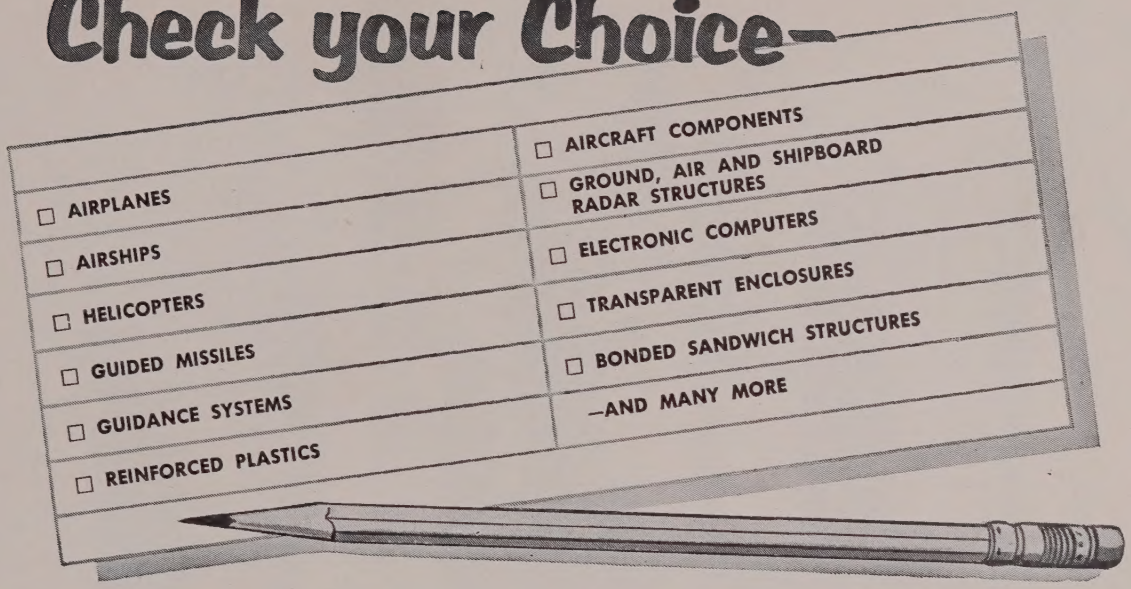

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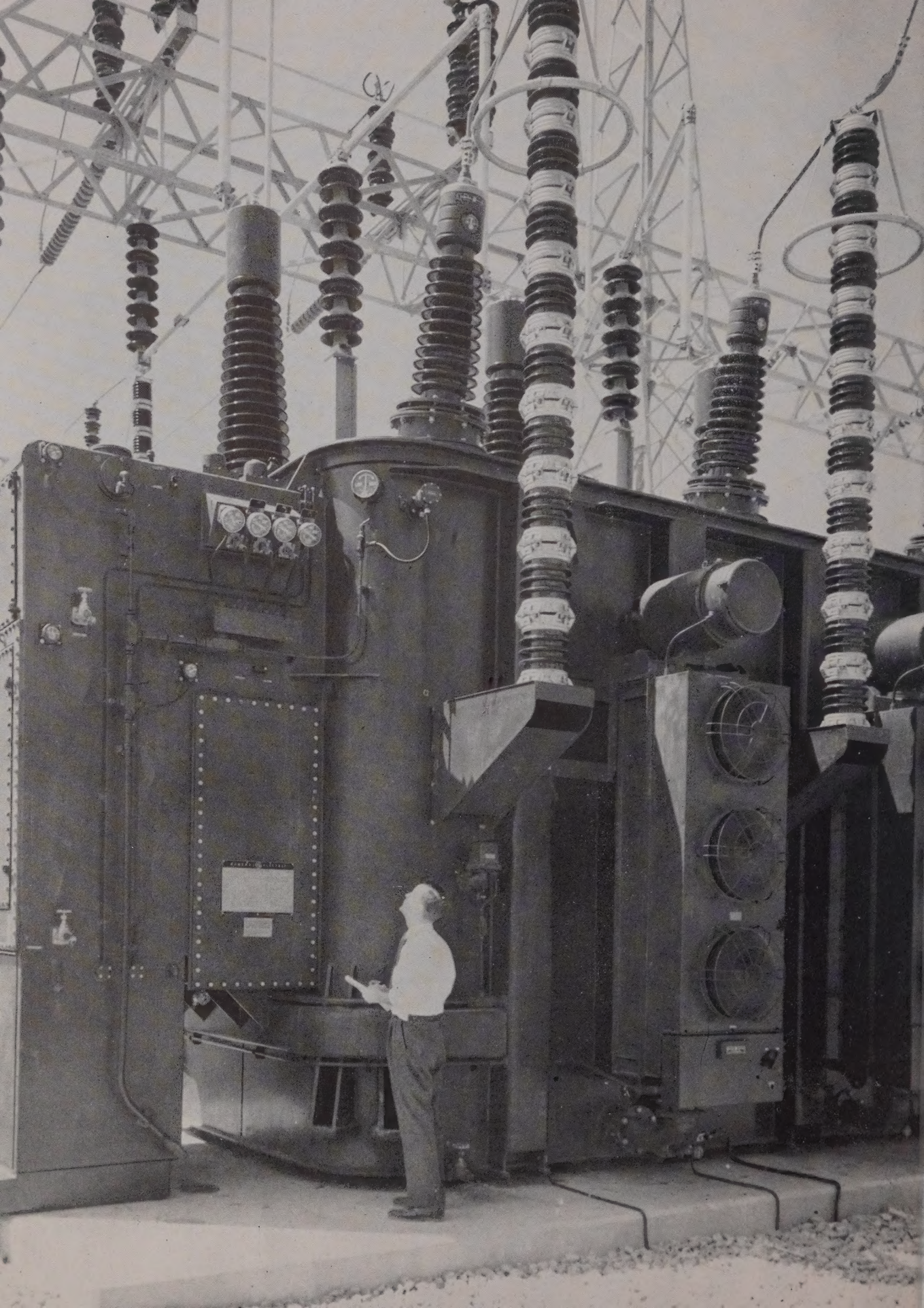

a look into . . .

Education

by John V. Zinkus, E.E. '53

What is education? Have we ever given any thought to the many aspects of this subject—this goal which we have set for our selves and our children to attain? Many other people have thought about education. The Greeks and Romans realized the necessity of forming concrete ideas about it, and many of their philosophers wrote volumes on the subject. It is a problem to be settled but we can not expect to settle it here. We can, however, add our thoughts to the collection already amassed and allow each individual to try to be guided by these thoughts.

We have set forth a problem, a problem which has confounded the ages because of its greatness and necessity—a problem whose importance can not be overlooked if our civilization is to progress.

Fundamentally then, we must establish what an educated person really is. We have many authorities, but there is among their ideas a conflict of thought. In general, they seem to agree, yet each has his own point to make. There is a belief held by some that the educated person must be a scholar in the arts and the less that the physical sciences clutter up his mind the better off he is. It would seem that this idea is very short sighted, for humans must appreciate the beauty of nature and its functions to understand the most basic art of all. In the understanding of nature, it is necessary, at least, to have some fundamental knowledge of physics, which is only the interpretation of the laws of nature. In the natural things of life, the ideas of greatness prevail. It is those things created by nature which are the most beautiful, and it does not take a person who is a student of the arts to realize that this is so. The most beautiful things are very nearly always the simplest things.

Although the expression of the human thought in paintings in our modern age is art, or is so acclaimed by the art critics, I myself can seldom see the thought in the brilliant splashes of color that the modernistic student of art emphasizes. I do not here wish to condemn art, for it is important that it should be understood and appreciated; yet I do not believe that an appreciation of the so-called modern paintings of today constitutes art appreciation. The educated man should appreciate the arts, fine music, (this does not mean only the classical music), good literature, and beautiful scenery, whether it be on canvas or a spectacular view of mother nature in all her glory. It seems then that the educated person should appreciate the arts, but that this should only be a component part of his educational background.

It would seem also that the educated man should have a concept of physics. It is not necessary that he should know how to build an atom bomb, but he should be able to realize the potential greatness that the world and nature can offer. Physics is only a word picture of nature, and to scientists and engineers a mathematical picture of the nature that surrounds us. It is a necessity that the educated person be able to reason in logical steps and to realize the necessity of knowing about the functions of nature. It is, also necessary that the eductated person should be able to distinguish between right and wrong logic as connected with ideas, for it is necessary to prove the worth of ideas. In the book *The Aims of Education* by Alfred North Whitehead, Mr. Whitehead has this to say:

> "Now an idea is not worth much unless the propositions in which it is embodied are true. Accordingly an essential part of the proof of an idea is the proof, either by experiment or by logic, of the propositions. But it is not essential that this proof of the truth should constitute the first introduction to the idea. After all, its assertion by the authority of respectable teachers is sufficient evidence to begin with. In our first contact with a set of propositions, we commence by appreciating their importance. That is what we all do in after-life."*

It is important, however, that in obtaining the scientific knowledge, that the mind should be trained to use the logic and knowledge that educated person has at his command. It matters not that a man have knowledge if he does not use it in some manner, either for himself or for others.

The educated person should also have some idea of the history of man. The history that he should know about is not a succession of dates by themselves, but that which is more important, the knowledge of the events which have caused the world to progress as it has. History reveals to us all of the errors in judgment of civilizations past, and with this knowledge the educated person should be able to form convictions and attitudes toward his fellow human beings in his association with them. Just to have knowledge of these things does not do the educated man or society any good, it is the application of this knowledge that is the true test of a man's ability and education. A scholarly attitude with no interest in the function of society in which we live does not produce an educated mind. The educated mind is active and should differentiate between the right and wrong philosophies of life, morals, and government.

If the educated person is to guide human beings at all he should have a knowledge of biology also, for it is the very fundamental knowledge of life. Through knowledge of biology and physics the secrets of nature are revealed to man. Through biology the drives of man and other living organisms are known to man, and through this knowledge the educated person can do what is necessary to guide his less fortunate fellow beings.

The educated man has a certain debt to society, because by nature of his education his opinions are sought and followed. It is therefore a prime necessity that the educated person be as well informed in all affairs as he possibly can. If it is impossible that he can not know all that transpires, he should at least realize the necessity of education and its applications to social and moral life. With all of these factors considered, there is still one that the educated person should have. To be truly educated and to make use of this education, man should also have a philosophy of life. He must have some goal or ideal

*Alfred North Whitehead, *The Aims Of Education*, page 15.

which he is seeking to find or attain and he should continually work toward this end. The man who has an education but does not use it will tend to be inept in his ideas and policies in life and in the business world. The educated man should realize the value of his education and the value of education among the general public, for it is through the education of the people that progress in civilization occurs.

We must consider of course how a person may become educated. How does one gain this knowledge to be classified as an educated man? One method is to obtain the beginning and the training in educational institutions, such as colleges and preparatory schools. We can not just attend a college and expect to gain an education, it will require great effort on the part of the individual involved. Just riding through on the crest of things does not constitute an education, even though we have a degree to show that we have spent the required amount of time exposed to knowledge. Another method of attaining an education is by searching by ourselves for the truth and the beauty in nature, by developing a philosophy of life that suits our own needs, and then by using this knowledge that we have assembled to guide us in our life in society. We can assume then that to become educated we must have an inquiring mind and a desire to find out the truth.

In conclusion then we can say that the educated man should have the following requisites; he should have a certain appreciation of the arts, a general knowledge of the sciences, an understanding of biology and history, and a philosophy of life; but what is most important is that he should know how to coordinate and use his knowledge for the progress of civilization.

Editor's Note:

All seniors in electrical engineering are required to prepare a thesis for senior seminar. The subject of the thesis is left to the discretion of the student, most students choosing a subject of technical nature. However, the author of this paper chose a non-technical subject, and with the help of extensive references and expressed ideas of numerous university presidents throughout the nation he succeeded in producing an outstanding thesis on education. John Zinkus graduated with a degree in electrical engineering in February 1953 and is now employed by Collins Radio Corporation in Cedar Rapids, Iowa.

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It took a lot of engineering to make a better "grasshopper"

Engineers at Western Electric's St. Paul Shops are well pleased with their new-style "grasshopper" fuse—a small fuse used in Bell telephone central office equipment. The former model—in production for years—had been gradually refined 'til it seemed almost beyond further improvement. It was simple, inexpensive, efficient, came off the line fast. But . . .

It's an old Western Electric engineering custom to keep trying to make Bell telephone equipment still better, at still lower cost. The "grasshopper" was studied by a young engineer out of the University of Minnesota, Class of '40, who joined the Company in 1946. His studies indicated the most effective way to improve efficiency and cut costs further was to change the design.

Pursuing this lead the engineer and his group saw their opportunity to make an important contribution. They investigated the latest tooling techniques, new metals, finishing materials and methods, all of which are constantly under study by engineers at Western Electric plants. A simplified design, which permitted the use of the most modern tooling methods, resulted in a better fuse at lower cost that is saving thousands of dollars a year for Bell telephone companies.

There's an endless stream of such challenging assignments at Western Electric. Engineers of varied skills—mechanical, electrical, civil, chemical, metallurgical—find real satisfaction in working together on the important job of providing equipment for the best telephone service on earth.

How the grasshopper fuse works

Small fuses like this are used by the millions to protect certain telephone central office circuits against current overloads. Odd in appearance, the fuse is called the "grasshopper" because of its spring which is released when the fuse blows, displaying an indicator "flag" in open view and tripping an alarm so the trouble can be spotted and corrected at once.

NEW DESIGN

ONE-PIECE FORMED SPRING WITH INDICATING FLAG—MADE BY STANDARD PUNCH PRESS METHODS.

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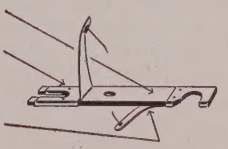
ASSEMBLED FUSE



BLOWN FUSE

• *Engineer and punch press operator check production of parts for newly designed grasshopper fuse.*

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

TV at the Chicago Professional College

by Warren H. Brandt, C.E. '54

Try to imagine the possibilities of a teaching medium that enabled 400 students to see a laboratory demonstration that formerly could accommodate a maximum number of twelve.

Of course, the teaching medium is television and it came into its own in dentistry at the University of Illinois College of Dentistry at Chicago on the afternoon of February 10, 1950. At a television presentation of "Theory and Practice of Periodontics" over 400 dentists attending the Midwinter Meeting of the Chicago Dental Society were spectators at professional demonstrations of various phases of dental and oral surgery techniques.

This use of the newest of the various communications media by the college of Dentistry was no accident or hastily conceived plan. On the contrary, ous communications media by the College's educational extension plans that have been in effect for some time. The forerunner of television as a teaching medium was the school's well-known Telephone Extension Program, a winter monthly feature sent out from the Dental College to 119 cities in the United States and Canada.

The dynamic force behind both the telephone and television programs is Dr. Saul Levy, assistant professor of Dentistry in the Department of Applied Materia Medica and Therapeutics. As Coordinator of the Postgraduate Extension Division, Dr. Levy was instrumental in setting up a suitable arrangement whereby unusual or advanced techniques in dentistry and oral surgery could be described and discussed by a panel of experts while the whole proceedings were broadcast to dentists throughout the country who had subscribed to the course.

The presentation of a program of the extent and scope of the Telephone Extension work involved an enormous amount of effort. At one time there were more than 250 cities in the network. The programs originate in Chicago at the Dental School campus. Moderators for the discussions during the programs include some of the most prominent dental surgeons from all parts of the country.

The present 1952-53 series of teaching over long distance telephone lines features *Current Advances in Dentistry*. This is the sixth year of this pioneering endeavor. On the first circuit back in 1947, were 20 dentists in Scranton, Pennsylvania. The following season 35 dentists in the Scranton area were enrolled together with a group of 25 dentists in New Iberia, Louisiana. In the fall of 1948, 150 dentists from 6 cities in Illinois were participants.

In October, 1949, the Telephone Extension Program was expanded on a national scale. At this time 5500 dentists in 143 cities from 42 states, the District of Columbia and Canada were registered for the course. For the 1950 program, 9000 dentists in 256 cities scattered over the United States and Canada heard the lectures and demonstrations.

The network to carry these programs throughout the country is provided by the American Telephone and Telegraph Company the same as it would do for commercial radio broadcasts. The difference is that the Dental College network requires a greater number of circuits than any commercial broadcast *ever* needed. The magnitude of the undertaking thus can be vividly compared to commercially sponsored programs that we hear every day on a national network.

At the transmitting end, the technical details of broadcasting are attended to by a staff of announcers and engineers from station WILL, the University's radio voice in Urbana. The use of WILL personnel at the studio imparts a professional broadcasting quality to the programs that has received considerable acclaim. The programs of course are not broadcast in the sense that the material goes out over radio waves, but are confined entirely to telephone lines from the transmitter to the thousands of receivers connected to special telephone circuits where ever an enrolled group is gathered. Thus, the telephone programs are really on a closed-circuit

basis insuring freedom from interruptions, mechanical interference, etc.

At the receiving end the dentists are gathered, often in some one's home, office or professional club, where the group has arranged for special amplification equipment to be set up by the local telephone company to insure that all members of the group can hear the presentations with equal clarity.

The telephone programs are offered during the fall and winter on the first Monday of each month. Each dentist who is a member of a group that has subscribed to the course receives an attractively printed manual to accompany the panel discussions. It is noteworthy to introduce at this point that the manual for the 1952-53 series of programs, which was printed and designed by the University of Illinois Press, received the award of exhibit in the American Institute of Graphic Arts "Printing for Commerce" show.

Many of the participating groups hold their own "round table" discussions following the broadcast. In this way the benefit of experience in some phase of the subject broadcast, by a member of a group is made available to all in that group. Comments by such a group as the Los Angeles Dental Society, California, give some indication of the success of the telephone venture, they said, "Monday's program was slightly terrific. Reception was excellent. Our dinner discussion was lively. This is the best yet." Such remarks from an assembly of dentists 3000 miles from the source of broadcast, amply prove the value of teaching via long distance telephone wires. Dr. Levy in noting this success says in his history of the Telephone Extension Program, "This particular teaching technic is looked upon with favor by the medical profession as indicated by the inauguration of similar programs by the Indiana State Medical Society in January, 1951, the Texas State Medical Society in February, 1952, and the Kentucky State Medical Society in 1952. We also have information that the American Medical Association is investigating the possibilities of a like program on a nation-wide basis in the near future.

Topics for presentation at the 1952-53 series of programs are Exodontia; Dental Materials and Therapeutic Aids in Everyday Dentistry; Removable Partial Dental Prosthesis; Treatment of Periodontal Diseases and Developmental Anomalies in Dental Practice. The last program was held March 9, 1953, and the moderator was Dr. Allan G. Brodie, Dean of the College of Dentistry of the University of Illinois.

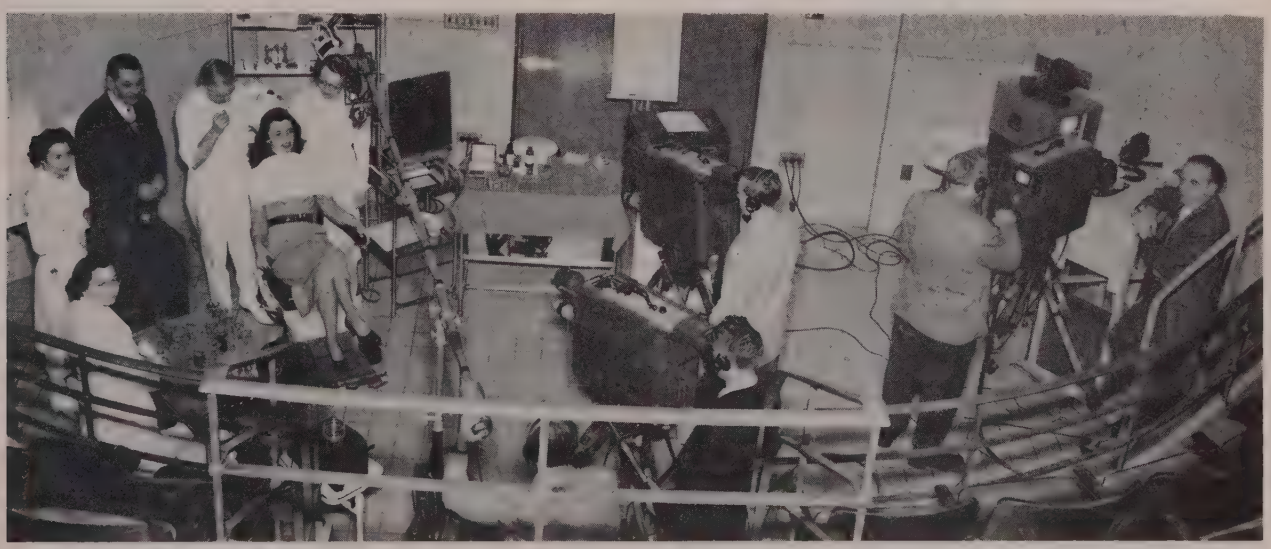
It was significant therefore, with this background of extension teaching that the role of television as a teaching medium would be examined.

When the Chicago Dental Society announced the dates for its 1950 Midwinter Meeting, Dr. Levy together with other members of the staff at the Dental School contacted TV station WBKB in Chicago to make arrangements for the station to furnish the necessary technical personnel, cameras and associated equipment to televise particularly important programs that were planned. Further agreements were effected with RCA Victor to provide the required number of television receivers and projection apparatus. All this equipment was rented from these companies by the University and technical personnel was provided by the station as mentioned.

The courses selected for televising were those that were of such a nature that did not lend themselves to demonstration before a large group. Among these were operations inside the mouth, structural theory relating to the placement of dental bridges, etc., with the use of the television camera, however, the groups arranged before the screens located throughout the Dental Building, were able to observe the innermost recesses of each patient's oral cavity and watch the dental operations and techniques used with ease.

Each day's demonstrations were followed with a round table discussion which was also televised thus reaching a larger audience than could possibly be accommodated in the most spacious hall on the Dental campus.

The highlight of the initial television presentation at the campus was the actual viewing through a microscope by the television camera of physiological specimens. It goes without saying that this technique alone would lend itself to a great number of applications throughout the sciences where ever a group is required to observe microscopic particles. The use of television in this connection with the resulting saving in time, ease of discussion by the lecturer and freedom from the distractions of having each member of the group peer through the microscope should be expanded and will be expanded as facilities become available. At the program in 1950, Dr.



Scene at the College of Dentistry television demonstration "Occlusion in Periodontal Practice." The gentleman at the left in the dark suit is Dr. Allan G. Brodie, Dean of the College of Dentistry. To his right is Dr. Balint Orban, Director of the Colorado Dental Foundation. Television technicians and equipment was furnished by station WBKD. (All photos courtesy of R. Lincoln Williston)

Balint Orban, director of the Colorado Dental Foundation, presented ten patients for operations. In addition to performing the actual operations before the television cameras, he showed the condition of tissues at various stages of intermediate healing through the microscope. This technique would almost be impossible if the 400 viewers had to gather around the microscope for a hasty glance. The possibilities here are unlimited.

The television demonstrations were repeated in 1951, to capacity audiences. It was about this time that plans were being made for the new Dental Buildings on the Chicago campus. As part of the wiring in the buildings the architects have provided co-axial cables between the lecture rooms to facilitate connections between TV cameras and receivers. This is in contrast to Dr. Levy's 1950 pioneering venture in television when he had the television station employees string their cables up and down the stairwells in the Dental College building. There is no reason to doubt that the co-axial cables in the new Dental Buildings will receive considerable use.

Aside from the ability of each member of the audience to see every demonstration and operation more clearly, the reduction in personnel necessary to assist in a demonstration is an important saving. Where one lecturer might give the same lecture several times, and his various assistants would be required to be present at each lecture; with TV the lecture need be given but once and a few aids are present to assist.

Dr. Saul Levy, of the University College of Dentistry, was instrumental in setting up its first educational television program.

Dr. Levy has many ideas to utilize TV on the undergraduate level as well as on the postgraduate level as has been done heretofore. As a pioneer in television at the University of Illinois, Dr. Levy can well expect that many of his unique innovations will be followed with interest by the new television station now being established in Urbana by the University.

In addition to the use of television on a closed-circuit system by the Dental College, the College of Medicine has cooperated with the Illinois State Medical Society in the presentation of a public service program over TV station WGN-TV (Channel 9) in Chicago. The series is entitled "How's Your Health?" and has featured prominent members of the Medical School faculty in discussions of various health topics.

The utilization of television as an educational medium is in its infancy. There are undoubtedly a great number of people who will dial out the common "blood and thunder" type of program in favor of an intelligently presented educational feature on the average listeners educational level, which is not as low as the cigarette ad men would like to make one believe it is. The colleges should take the lead in presenting programs of this type, their assured success will be an indication that the public still is interested in learning about themselves, their environments and their neighbor's environment whether he be in the next city or halfway around the world. The Chicago Professional Colleges have set a pace for the Urbana campus and it is hoped that the downstate television venture will have the same measure of success that has accompanied their monumental and pioneering effort.

The EE says:

If your sweetheart is a blond and you love a brunette, transformer.

If she gets grouchy, tickler.

If she wants to meet you for lunch, meter.

If she wants a fur coat, resistor.

If she continues to insist, eliminator.

She is easily induced by lines of force.

She is usually in a steady state.

She has no known imaginary components.

She has a continuous curve.

She has a negative temperature coefficient of resistance.

She has a high capacity when charged.

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Fafnir is the largest independent manufacturer of ball bearings in the country. From 1939 to 1950 its annual steel consumption increased almost 300%.
50,000 r.p.m. and not a tremor!
You can put your thumbnail against high speed machine tool shafts supported by Fafnir Super-Precision Ball Bearings and not feel vibration. Such smoothness of operation assures extremely accurate, fast work and prolonged life of parts.
The achievement of such results takes more than skill and care in the manufacture of ball bearings . . . it takes an "attitude and aptitude" for approaching bearing problems from the customer's viewpoint . . . gained from experience in not one or two but all industries. The Fafnir Bearing Company, New Britain, Conn.
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Best ECMA Article of the month . . .

TV for All

by Ed Bescherer, The Purdue Engineer

On September 4, 1951, forty million televiewers across the nation witnessed President Truman delivering an address to the Japanese Peace Treaty Conference in San Francisco. This was made possible by the magic of television and the new TD-2 Radio Relay System, which for the first time made a coast to coast TV broadcast possible. TD-2, a part of American Telephone and Telegraph's communication system, connects such important cities as New York, Chicago, Denver, San Francisco, and Los Angeles. A total of 52 cities have now been linked by this vast system.

Although TD-2 is often thought of in connection with the transmission of the television programs, it also has another important function. This is the carrying of many long distance phone calls. TD-2 is capable of carrying as many as six television channels or over a thousand telephone channels.

Basically TD-2 consists of a series of 107 relay stations spaced across the country. At each of these stations the television and telephone channels, which have been translated into super-high frequency microwaves, are received, amplified and then transmitted to the next station. In order to accomplish this task each station is equipped with four big antennae, two receiving and two transmitting, so that microwaves may be passed in both directions. Included at each station is the necessary equipment for handling and amplifying the microwave signals.

A Line-of-Sight Path

Selecting the sites and building the relay stations proved to be a very difficult job. Since microwaves travel in approximately straight lines, the stations had to be built on a line-of-sight path. Sites were chosen at rather short intervals (averaging distance 27.9 miles) and wherever possible on elevated locations so that a satisfactory line-of-sight path could be achieved with towers of structurally reasonable height.

Before the permanent relay towers were constructed it was necessary to run tests on the prospective sites. This was done with unique portable microwave towers, which could easily be raised to a height of 200 feet. The towers, consisting of numerous eight foot sections, were assembled completely from the ground. An erection frame placed at the bottom of the tower was used to lift the incomplete tower so that the eight foot sections could be added from he bottom. With the desired height reached, tests could be run to determine the acceptability of the sites.

Relay stations of several structural types were employed in the TD-2 system. Quite often in large cities the antennae were placed atop tall buildings with the rest of the equipment being stored inside. The remaining stations in the system fall into three general structural groups. Between New York and Des Moines, Iowa, the relay stations were built inside tall concrete towers with the antennae on top and the amplifying equipment in the tower. West of Des Moines the relay stations were housed in small buildings

The LaSalle, Michigan relay tower of the Detroit to Toledo system. (All photos courtesy Purdue Engineer)

with the antennae atop high steel towers. The high natural elevation of sites on the west coast permitted a few stations to consist of single story buildings with the antennae on the roof. The tallest tower in the system reaches a height of 206 ft.

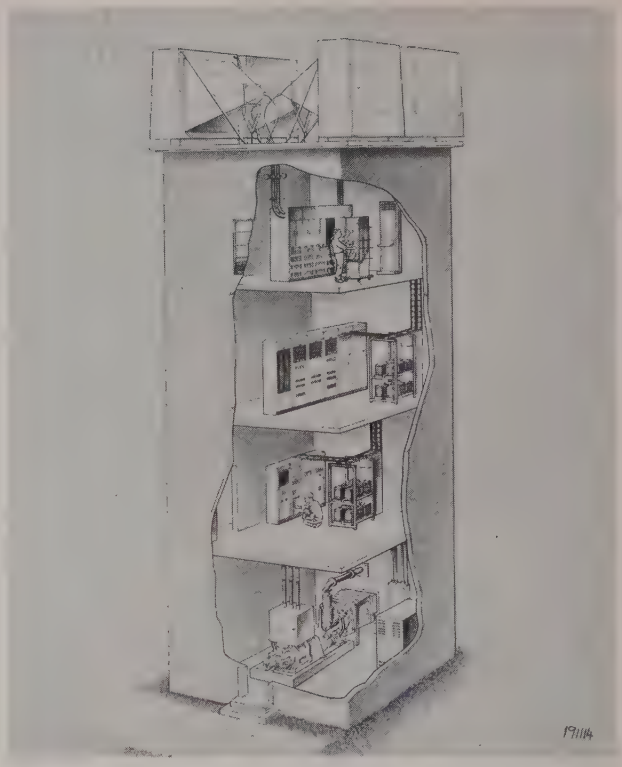
The delay lens antennae which plays such an important part in the system was especially developed for TD-2. The front of the antenna is a lens housing 10 ft square and 3 ft deep, which covers the delay lens. Behind the lens is a pyramid shaped horn, and feeding the horn is a wave guide which connects the antennae to the rest of the relay equipment in the lower levels of the tower. Microwaves being transmitted from a station come through the wave guide and horn until they reach the delay lens. The lens focuses them on the next station in much the same manner as light is focused by a search light.

Twelve Channels Minimize Interference

TD-2 operates over 12 channels; six in each direction. Each channel occupies a specific 20 mc band in the 3700 to 4200 mc common carrier band. The six channels in one direction use the same antenna and are spaced with the mid-band frequencies 80 mc apart. The six channels in the opposite direction, using the other antennae, are spaced equally between the first six channels so that actually there is a 40 mc separation between mid-band frequencies of adjacent opposite channels.

Each channel is assigned two frequencies 40 mc apart. The receiving and transmitting functions are alternated between these two frequencies at every station. By this means channels always leave a station on frequency 40 mc different from that upon which they entered, thus avoiding feedback around the antenna. This does not result in the loss of bands since a channel in the other direction is alternated on the same two frequencies. Since a channel is repeated on the same frequency at every other station, it was necessary to avoid placing the stations in a straight line in order to prevent overshooting. This was another factor to contend with when sites were being chosen for the stations.

This radio relay tower at Lake Zurch, Illinois, is for television network between Chicago and Milwaukee.



A cutaway view of a typical concrete station in the Transcontinental Radio Relay System. On the first floor is the diesel or gasoline engine for emergency power. The second and third floors house the main power supply. Amplifying and testing equipment occupies the top floor. The antennae are found on the roof.

Three functional types of relay stations are in operation along the TD-2 system. At the end points are the terminal type stations. Here the signals, either television programs or telephone circuits, enter and leave the system.

When a signal first enters a terminal station it is impressed on a 70 mc carrier in a unit known as the F. M. Terminal Transmitter. The 70 mc carrier is passed through a patching and monitoring bay where it is switched and monitored as desired. A radio transmitter then translates the signal to microwave frequencies and amplifies it. The microwaves are combined with the other channels and sent toward the next station.

Connecting the terminal stations are many auxiliary repeater stations. Here the microwaves, after being gathered by receiving the antennae, are separated into the various channels by a channel branching filter. Each channel is lowered to an intermediate frequency of 70 mc and sent to a radio receiver where it is amplified. A radio transmitter restores the channels to microwave frequencies 40 mc removed from the carrier on which they were received. The combined channels are then sent to the next station. Auxiliary repeater stations such as this are run completely unattended.

The third type of relay station in the system is the main relay station. Main relay stations were placed at points where it was desirable to be able to break into the system for adding or dropping of channels or for monitoring

operations. These stations are generally located in the larger cities along the route. In addition to the equipment found in an auxiliary station, main relay stations are provided with intermediate frequency patching bays for all switching and monitoring purposes.

When the early planning was being done on TD-2 it became obvious that a new type of electron tube would be necessary to meet the requirements of the system. Research by the Bell Telephone Laboratories led to the development of a new and very small tube known as the "close-spaced triode." This new tube has a space equal to about one-fifth of the diameter of a human hair between the grid and cathode. The grid wires are three ten-thousandths of an inch in diameter and are wound a thousandth of an inch apart. The "close-spaced triode" has extensive use in repeater and terminal equipment where it is used as an amplifier, modulator, oscillator and frequency multiplier.

Alarm System Prevents Breakdown

Due to the importance of maintaining uninterrupted telephone and television service it was necessary to incorporate into TD-2 a reliable alarm system. The alarm system developed for TD-2 greatly reduces the chance for a breakdown in the system. It operates through a series of alarm centers placed along the line. The system performs two functions: the first is reporting of detailed information to the alarm center of trouble at any unattended station, and the second is the sending of orders from the alarm to the affected station. An alarm center may be responsible for six unattended stations in each direction, a total of 12 stations.

A check on each station is maintained by the monitoring of a characteristic tone at the alarm center. Failure of the tone gives warning of malfunctioning at the station associated with that tone. In response to the warning an attendant at the alarm station sends out an order to the affected station, which by electrical means asks what is wrong. The alarm system is then able to report on any of 42 conditions which might be causing the trouble. After analyzing the trouble the attendant may send one or all of a maximum of ten orders to make the proper correction.

In addition to the alarm centers, maintenance centers were also installed in the system. These centers are responsible for the repair and periodic maintenance of the relay stations.

A TD-2 relay station operates on three power supplies: 12 v, 130 v, and 250 v. The power is drawn from batteries which are floated by a series of rectifiers operating from commercial 60 cycle power. An auxiliary power supply has been provided for times when the commercial power supply fails. On such occasions the batteries carry the load for about 8 min until an automatic gas engine or diesel engine alternator is warmed up and resumes the floating operation. In case of engine failure the batteries are capable of carrying the load for 8 hr, which would allow sufficient time for a repairman to reach the station.

A system of such a complicated nature as TD-2 was not developed overnight. The fact that this system exists is the result of years of work by the Bell System. Experimental work was started on a system of this nature by the Bell Telephone Laboratories at the end of the last war. The first experimental microwave relay system was set up between New York and Boston. This TD system was the forerunner of the TD-2 system.

As can be seen, the utilization of microwaves for use as a commercial communications system is a fairly new concept. In spite of this, the idea is spreading very rapidly. At this time plans are being made for enlarging the system. In the next few years the entire nation will be drawn close together by TD-2.

Horace Greeley's advice is still good . . .

"Go West, young man... go West"...

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NAME	DEGREE	YEAR
WILLIAM H. BECK	MS ME	1952
ROBERT GOODYEAR	BS ME & EE	1933
ROBERT STIENECKER	BS AE	1940
R. P. LUCAS	BS AE	1952
AUGUST QUENON	BS E	1952
KENNETH E. WELCH	BS AE	1948

Inside Industry . . .

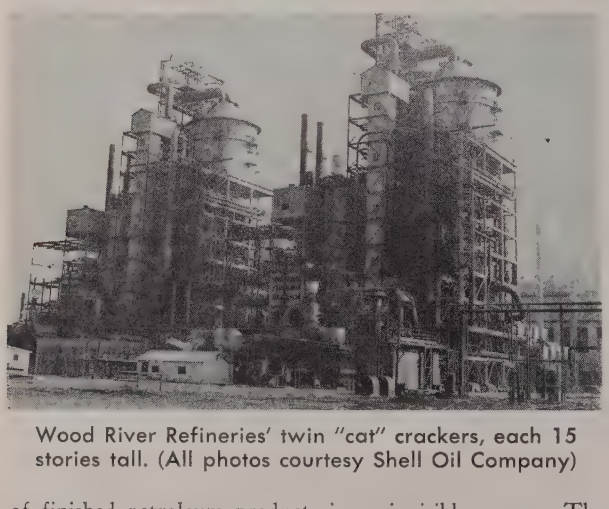
THE SHELL OIL COMPANY

Wood River Refinery

by Tom Tucker, Ch.E. '53

Forty-two gallons make one barrel, but 170,000 barrels are needed to make one day at the Shell Oil Company's Wood River, Illinois, refinery. But crude oil processing is only one phase of the operations at the refinery, for the main product development and application laboratory is located there.

The oil refinery is not a spectacular industry to the eye, as is the automobile industry, for the manufacturing



Wood River Refineries' twin "cat" crackers, each 15 stories tall. (All photos courtesy Shell Oil Company)

of finished petroleum products is an invisible process. The crude oil arrives by pipeline or tanker, is refined and reformed in steel equipment, and departs by pipeline, railroad, or truck without being seen. But, if the eye can not see the drama of oil, the mind can.

Only a century ago, petroleum was considered good only as a medicine. Today, petroleum is the source of 1,000 products. A century ago, oil was of concern only to the man who happened to be unlucky enough to have it on his property. It ruined his crops. It was almost impossible to sell. Today, oil is a fundamental concern of every government on this earth. The man with oil on his land can often forget about farming it. Oil! Rightly may it be called "black gold."

The drama of oil is in two acts. The first is entitled "production." The second is "research."

Although Illinois produces crude oil, that for the Shell refinery travels in 10-inch and 22-inch pipelines from fields as far away as West Texas, a distance of 900 miles. The crude is stored until needed in the refinery's 400-million-gallon "tank farm."

From the storage tanks, the sticky, viscous crude flows to the crude distillation units. Here it is heated and passed into fractionating columns. Crude oil is composed of many different hydrocarbons, each with a different boiling point. In the fractionating column, the low-boiling components are condensed in the cooler, upper section of the tower. The compounds with high boiling points collect in the lower section of the tower. From various points along the column, the primary ingredients of the oil are removed for further processing. From the top comes gasoline stock, then kerosene, a heavier gasoline stock, Diesel fuel stock, and others on down to the asphalt residue.

Formerly, this crude distillation was all the refining crude petroleum received. But petroleum, like a man with a sixth-grade education, could not take on the complex requirements of the world without more preparation. More powerful gasolines were needed. Special lubricating oils became necessities. More gasoline and less kerosene than simple distillation produced was demanded by the consumer.

The lubricating oil stock from the fractionation unit is first treated to remove asphalts. Then the stock is chilled to the point where the waxes solidify and can be filtered out. Resins, tars, and other sludge-forming materials are then removed by a special solvent. The oil is filtered through clay to remove undesirable color. Finally, the various lubri-

cating oil base stocks are blended together with special additives to make the various lubricants for which Shell is especially known.

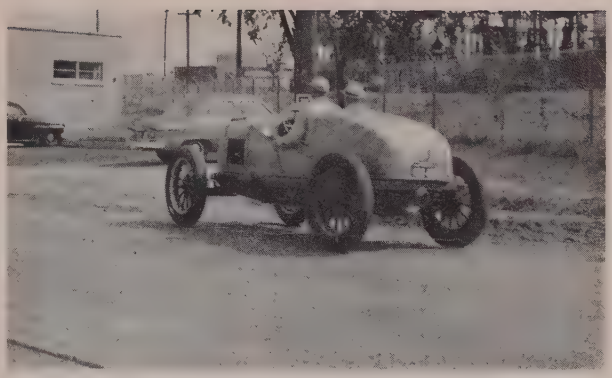
The manufacturing of motor gasolines is more involved than that of lubricants. While lube stock is taken from one part of the fractionating tower, gas stocks come from various parts. A portion of the high-boiling stock normally sent to the lube division is passed into the vacuum flasher. In this spherical unit, the remaining low-boiling compounds are separated from the asphalt-like base stock. Both the flashed distillate and the flasher bottoms are charged to the cracking units.

Two Types of Crackers Employed

Two types of crackers are in use at Wood River. The more common, and older, thermal cracker uses heat and high pressure to break the heavy hydrocarbon molecules into lighter ones. The Wood River thermal crackers are also used as additional crude units by feeding some crude along with the regular cracking stock. The catalytic, or "cat" cracker operates at lower pressures and temperatures, in addition to being more efficient than the thermal cracker. The units which Shell operates are the fluidized bed type. (The manner in which the solid catalyst is moved like a fluid was the subject of an article in an earlier issue of the *Illinois Technograph.*) Most refineries are not large enough to keep one such unit in operation. The twin "cats" at Wood River are not large enough for the rest of the refinery.

Some of the cracked stock goes directly to the light oil treaters to have objectionable odors removed before it is sold as motor gasoline. A heavier portion is sold without further treatment as fuel oil. Another product of cracking is coke. In the "cat" crackers, the coke collects on the catalyst and must be burned off. The heat produced is used in other sections of the refinery. The coke from the thermal crackers is sold to consumers of high quality carbon. The remaining products of the crackers are light hydrocarbons and undesirable isomers. These are fed to the gas plant to be separated and stabilized.

This gas plant separates the stock from the crackers plus stock direct from the crude units into stabilized gasoline (that from which the more volatile components have been



The winning car crossing the finish line in the mileage marathon.

removed), propane, butanes, butenes, and other special cuts. Again the gasoline is sent to sales after being de-odorized. The butenes and butanes plus the propane are fed to the polymerization and alkylation units. These units put the light molecules together to form gasoline components. Some of the propane is sold as bottled gas. Other products of the gas plant are isomerized, or reformed by subjecting them to high temperatures and pressures over a catalyst.

The lightest cuts from the crude units and part of the straight run naphtha, which is also fed to the crackers, goes into specialties manufacturing. These varied products consist of aromatic compounds, special solvents, aviation gasoline base stock, motor gasoline, and jet fuel.

Process De-odorizes Products

As previously mentioned, the light oil treating plant removes the odors from gasoline. Kerosene and fuel oils from the crude distillation units are also de-odorized by the plant. The objectionable odors which must be removed are due to mercaptans present in all crude oil (normal butyl mercaptan is the defensive weapon of the skunk). These troublesome sulfur compounds are de-odorized by being changed into disulfides. This requires more sulfur than is in the oil. Since sulfur lowers the anti-knock quality of a gaso-

This 85-ton, 122-foot column for rectified absorber at gas plants being raised by a 150-ton temporary guy derrick. This operation is typical of several being performed in construction areas in the refinery.

line, more tetraethyllead must be used. Some refineries have installed units to recover elemental sulfur from these oils, but present process is not efficient enough to be installed at all refineries. Here research will find the answer. Perhaps the reader of this article will be the one who discovers the process. But in all probability, he will not be, because the oil industry will have found the method before he has a a chance to finish his training. Such is the rate of progress in petroleum.

A 1932 Plymouth, which took third in the Class I competition, crossing the finish line.

The winner's car of the mileage marathon is given considerable interest by the crowd.

Shell is one of the leaders in petroleum research. At Wood River, the product development and application laboratory is responsible for improving the performance of internal combustion engines and other machines using petroleum products. One of the problems which has been studied in recent years is the fouling of aircraft sparkplugs. A fouled plug wastes fuel and causes high stresses in the engine. But the fouling is due to lead from the tetraethyllead used to produce high antiknock ratings. Shell research found an additive which did a more effective job of removing the lead than did the ethylene dibromide then used. The twin results of this research were fuel savings for the users of aircraft gasoline and added safety for air passengers.

In another part of the Wood River research laboratory, there is a jet engine burner with a window in it. Through this window, Shell engineers can observe the process of combustion with various types of fuels. The ultimate goal is, of course, the best combination of burner design and fuel.

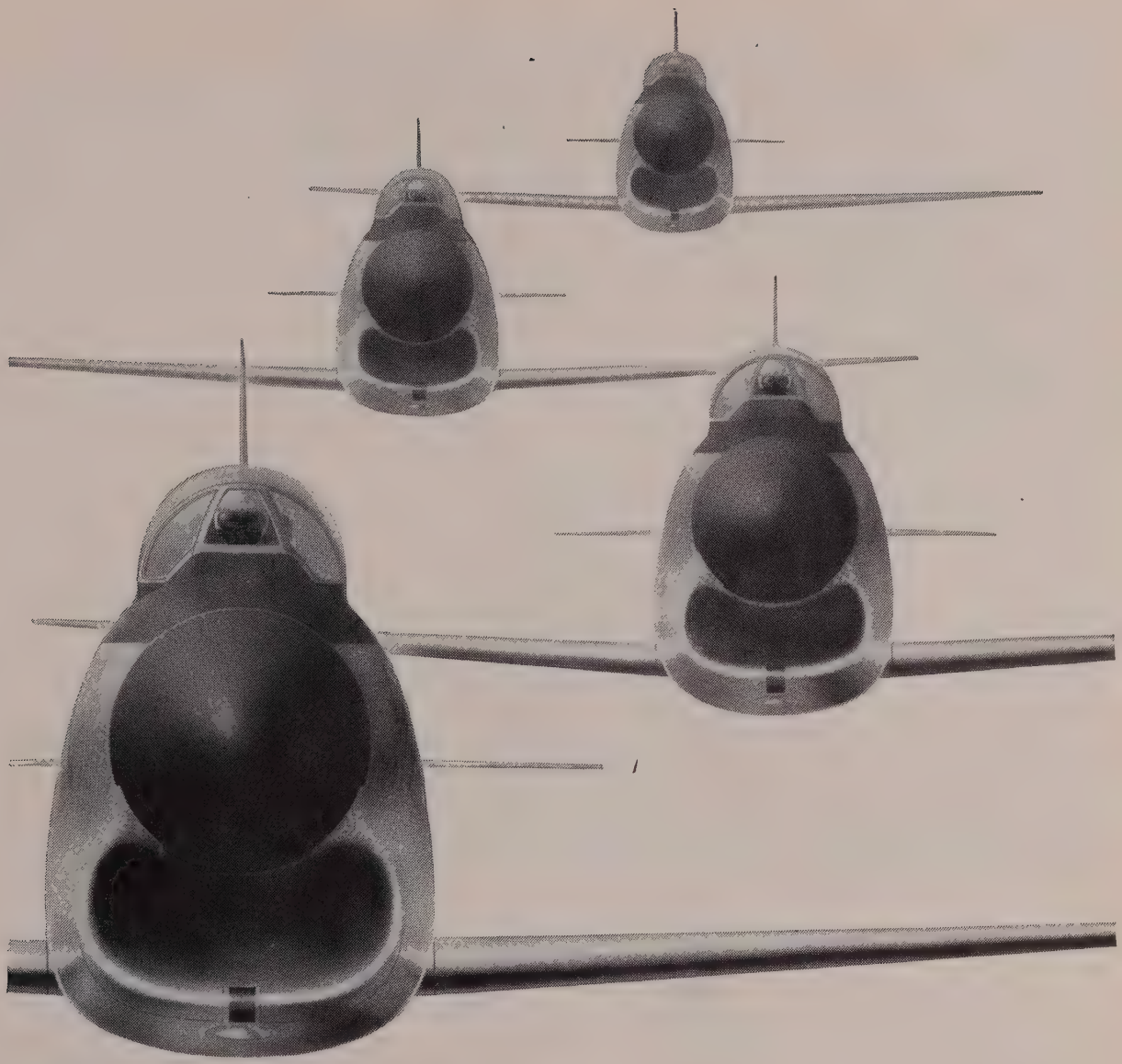
Perhaps the one bit of research at Wood River which receives the most publicity is the semi-official Shell Mileage Marathon. It started in 1939 as the result of the inevitable gas mileage comparisons between car owners. That year research director R. J. Greenshields won the Marathon, and thus the argument, by driving his 1933 Plymouth at the rate of 49.73 miles per gallon. Since that time, the chemists and engineers of the research laboratory have competed every year except during the war to see how high they could run their gas mileage.

Although the average motorist would not care to drive under the conditions necessary to win the Mileage Marathon, much has been learned that can be of value to him. For example, in his 1947 Studebaker, Mr. Greenshields achieved 149.95 miles per gallon in the 1949 Mileage Marathon. But to do so, he had to make the following alterations: the compression ratio was upped from 6.5:1 to 10:1; the rear axle ratio was changed from 4.56:1 to 3.2:1; 7.00x16 tires were substituted for the standard 5.50x15 tires; the tire tread was buffed until only a narrow ridge touched the road and the tires then inflated to 110 *psi.;* and finally, all the engine accessories such as generator, water pump, and fan were disconnected. But the greatest portion of the increased mileage was due to the driving method. The car was accelerated in high gear to a speed of about 20 miles per hour. At this point, the engine was turned off and the car allowed to coast to a speed of 5 mph, when the engine was restarted and the cycle repeated.

Family Car Has Surprising Results

Because a few men in the research laboratory were working over cars to be used only in the Mileage Marathon, a second class of contestants was created. This class is for the ordinary family car. But even the family car can deliver some spectacular figures. In 1950, the winning 1947 Nash averaged over 79 miles per gallon. The winner of the 1952

Mr. and Mrs. V. M. Reedy, Class II winners, receive their trophy from G. C. Cunningham.



How would you like to make history?

The men who designed the F-86D *Sabre* Jets you see above made history. And so did the North American engineers who designed and developed the leading planes of World War II—the B-25 Mitchell and F-51 Mustang—and the other advanced planes in the *Sabre* Jet series. For 24 years North American engineers have been making history, because North American thinks in terms of the future. That's why North American always has career opportunities for young engineers who do fresh thinking, for young engineers with new ideas.

Today, North American engineers are making history in exciting new fields, including aircraft, guided missiles, jet engines, rocket development and research, electronics, atomic energy. Why not consider joining them when you complete your engineering training? In the meantime, feel free to write for any information you might want concerning a career in the aircraft industry.

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contest averaged over 169 miles per gallon in his reworked 1924 Chevrolet.

Perhaps the most important recent development to come from a Shell laboratory is the "Turbogrid" distillation tray. This product of Shell Development Company, subsidiary of the Shell Group and the research laboratory at Houston, Texas, promises to replace bubble-cap trays. The bubble-cap tray has a U-shaped cap suspended over an open pipe so that the vapors rising through the pipe must reverse direction twice to pass through the liquid on the tray. In contrast, the "Turbogrid" consists of a metal grating with slots of appropriate size. The tray can be built up from bar stock or it can be stamped out of sheet stock.

Besides the obvious advantage of a lower initial cost, the "Turbogrid" has a capacity of 50 to 100 per cent more than a bubble-cap tray of the same diameter. The construction of the tray gives increased turbulence, thus increasing the separation effected by each tray. The increased efficiency of the "Turbogrid" is also due to the absence of downcomers (pipes which remove the excess liquid from a tray by allowing it to flow down to the tray below), which allows utilization of the entire cross-section of the distillation column. The new trays can be made of corrosion-resistant alloys at far lower costs than would be possible for bubble-cap trays. And reversing the reaction of the bubble-cap tray, the new slotted tray increases in efficiency with increasing loads.

Personnel Turn-over is Low

The Shell family of employees is a happy one. Nearly three-fourths of the employees of the Wood River refinery have been with Shell for 10 or more years. The wages of the refinery worker are among the highest of all manufacturing industries. In addition to the usual vacation and insurance benefits, the Shell employee can purchase insurance which will pay up to 40 per cent of his regular wages when he is disabled. This insurance is in addition to disability benefits which Shell pays all its employees of one or more years.

After retirement, the Shell employee may have an income from three different sources. Shell pays a pension up to 40 percent of the employee's highest average earnings for five consecutive years during the last ten years that he is employed. When the employee receives Social Security payments, his Shell pension is reduced by the amount of the Social Security due to his earnings as a Shell employee. The third source of income is the Shell Provident Fund. Under this plan, the employee may contribute up to 10 per cent of his regular salary to a trust account which is paid upon his retirement. For every dollar the employee saves in this fund, the Company adds another.

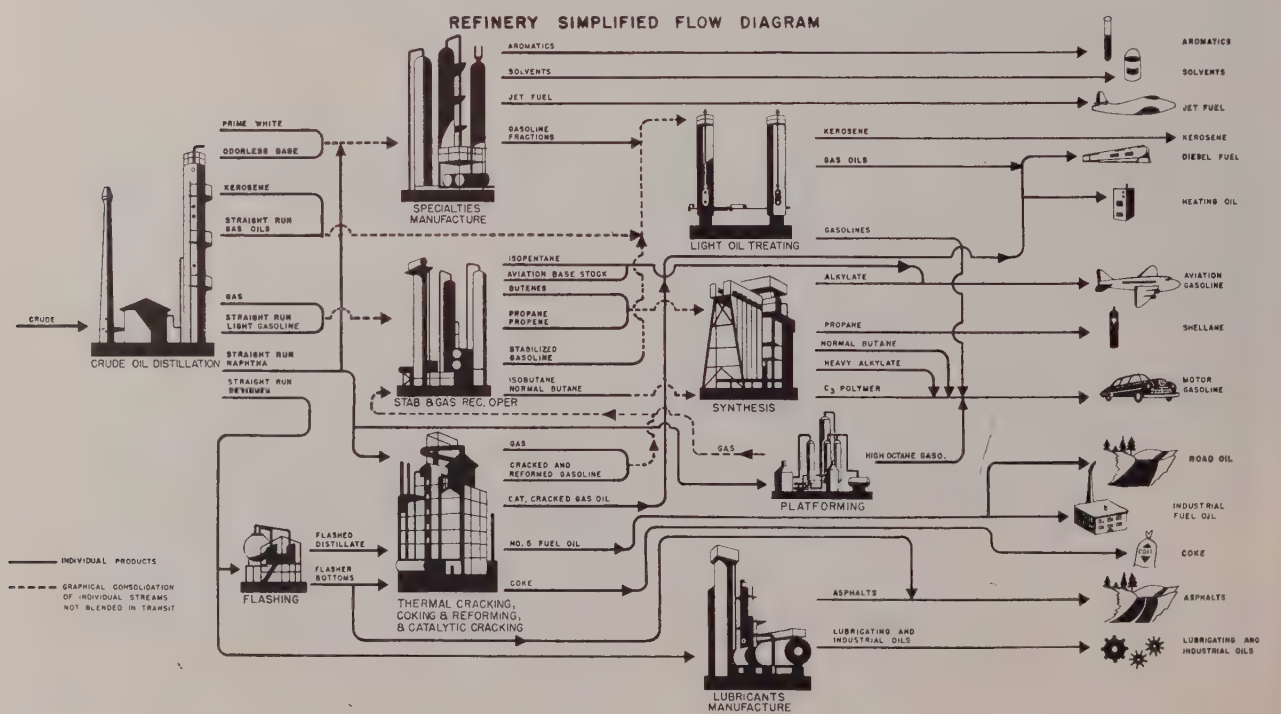
Health, Safety Program Successful

Promotion at Shell is based primarily on ability, but in the case of two equally qualified men, seniority is the deciding factor. A second factor in the Company promotion policy is constant supervision of all employees. No good job goes unnoticed and therefore unrewarded.

The health and safety of the Shell employee is well guarded at Wood River. Registered nurses are on duty in the emergency hospital 24 hours a day. During the day shift, the company doctor in charge of the hospital is available to all employees. The hospital staff also instructs all supervisory personnel in first aid. This instruction has been invaluable. Last summer, the life of one worker was saved when two of his supervisors applied artificial respiration after a heart attack. The record of less than three disabling injuries per million man-hours worked is less than half that of the whole refining industry.

The refinery sponsors many sports and social events. Some of the teams play only intra-plant games, but others compete with other industrial teams of the area. A tennis court, horseshoe pits, and softball diamonds are located on refinery property. The social functions include dances, picnics, and outings.

Chemical, civil, electrical, mechanical, metallurgical, mining, and petroleum production engineers can all find good jobs with a future at the Shell Oil Company.



INDIANA STIRRING SAND Corrosion Test, developed in Standard Oil laboratories, is operated by Technician John Becich. It measures the corrosion of bearings due to oxidation of motor oil.

Some men can't wait for time!

The familiar saying that "time waits for no man" has been given a reverse twist by Standard Oil scientists.

These chemists and engineers, impatient with time's measured pace, *don't wait for time.*

In our research laboratories at Whiting, for example, scientists discover the effects of months, even years, of elapsed time on petroleum products in a few hours. They artificially age certain products as much as 12 months in five hours. Some of these aging processes have originated in Standard Oil laboratories. Two such tests are the Indiana Stirring Sand Corrosion Test and the Indiana Stirring Oxidation Test. In two days these two processes determine the effect upon oil of months of normal driving.

Other artificial aging processes include the weatherometer, which manufactures rain, sunshine and heat to test the wearing quality of asphalt. The gasoline stability test uses heat, and oxygen under pressure, to determine how long gasoline can be stored without deteriorating.

This speeding up of time is characteristic of the restless curiosity that makes it possible to bring new and improved products to Standard Oil customers years sooner than might otherwise be possible.

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retiring . . .

Dean Harvey Jordan

by Hank Spies, Editorial Assistant, Engineering Experiment Station

Harvey H. Jordan was born in Waltham, Maine, on March 7, 1885. He received a Bachelor of Science degree in Civil Engineering from the University of Maine in 1910.

He has been with the University of Illinois since 1911. He was successively instructor, assistant, and associate profesor of engineering drawing until 1921, and professor of engineering drawing and head of the department of General Engineering Drawing from 1922 until 1949. He was Assistant Dean of the College of Engineering from 1917 to 1934, and has served as Associate Dean since that time. He also served as acting dean of the College of Engineering from June, 1929, to October, 1930, during the illness of Dean Milo S. Ketchum.

The position of director of student placement of the College of Engineering has been capably filled by Dean Jordan for the last dozen years. Under his guidance, the placement program has grown to the extent that nearly four hundred companies conducted more than fifty-six hundred student interviews in the school year 1951-52.

The official history of the University of Illinois College of Engineering describes Associate Dean Jordan as "particularly efficient, being resourceful and energetic, orderly and systematic, tactful but prudent, firm but understanding and sympathetic in dealing with students."

He has played a prominent part in the development of "College Days" in high schools. He served as chairman of the University committee on "College Days" from 1939 to 1943.

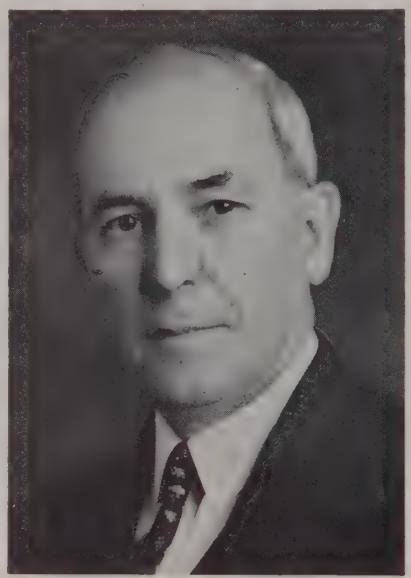
Dean Jordan is co-author of two books, *Engineering Drawing* and *Descriptive Geometry,* and an Engineering Experiment Station bulletin on "The Pipe Orifice as a Means of Measuring the Flow of Water Through a Pipe."

Dean Jordan has been very active in his interests outside the University also. He was an alderman of the city of Urbana from 1921 to 1927. He was vice-president of the Society for the Promotion of Engineering Education, now the American Society for Engineering Education, in 1931 and '32, and was a member of the executive council from 1924 to 1927.

He is a member of the American Society of Civil Engineers, American Association for the Advancement of Science, Illinois Society of Professional Engineers, Phi Eta Sigma, Tau Beta Pi, Phi Kappa Phi, Sigma Tau, Chi Epsilon, Triangle Fraternity, Masons, University Club, and the Champaign-Urbana Kiwanis Club, which he served as president in 1936.

Each summer, he enthusiastically vacations in North Central Wisconsin, where he owns two cottages on Plum Lake.

Dean Jordan will be honored at a testimonial dinner scheduled for 7 p.m., May 15. Short talks are to be given by



DEAN HARVEY H. JORDAN

President George D. Stoddard, Dean William L. Everitt, Charles A. Davis of Moline, Chairman of the Engineering Alumni Committee , and Clyde L. Young, President of the Engineering Council. Professor Randolph P. Hoelscher, Dean Jordan's successor as head of the department of General Engineering Drawing (now the department of General Engineering), will be the master of ceremonies. Professor Hoelscher serves on a committee, headed by Assist-Dean Stanley H. Pierce, which is arranging the May 15 ceremony.

On behalf of the students, faculty, and alumni, a fund will be established to support the Dean Harvey H. Jordan Award. Personal gifts will also be presented to Dean and Mrs. Jordan.

The General Engineering and Mechanical Engineering departments are planning tributes, as are several firms with whom Dean Jordan has worked in his capacity as College of Engineering placement director.

Richard Rider

by Fred Kuhlemeier, E.E. '56

Richard Rider, supervisor of Television-Motion Pictures, has been here at Illinois since 1950. Originally from Council Bluffs, Iowa, he received his A.B. degree in English at the University of Nebrbaska in 1937. Since then he has gained an extensive amount of experience both in the field of education and the entertainment world.

After college, and up until 1940, Mr. Rider worked in New York as an actor, both on stage and on the radio. In 1940 his career was interrupted when he became an officer in the Army Air Corps, where, during the war, he flew a B-24 Liberator Bomber. After the war he continued his studies at Yale University and in 1947 he received his Master of Fine Arts degree from the Department of Drama. During the summer that followed Mr. Rider worked for Louis deRochemont, a Hollywood motion picture producer. In the fall he once more went back to school; this time as an instructor in the Fine Arts College at the University of Missouri.

During the remainder of 1948, after the school term was over, and the first part of 1949 he was employed by two television stations. The first, WBKB in Chicago, and the second, WLWC in Columbus, Ohio. While in Columbus Mr. Rider began studying for his Ph.D. at Ohio State University. Then in 1950, after completing two quarters at Ohio, he came here to Illinois to continue his studying.

His first job at the University (during 1951 and early 1952) was managing the National Association of Education Tape Network. This network makes educational tape recordings for more than seventy-five radio stations throughout the country. In July, 1952, he became supervisor of Television-Motion Pictures, Division of Communications. This department, which is located in the stadium, is well known because of its many collegiate functions which includes the making educational films for future television stations of this area, producing of films of all Illini football games, and the closed circuit televising of both Illini home basketball games and the state high basketball tournament. In the fall of 1953 this department, Mr. Rider says, will offer a new curriculum to students interested in television production.

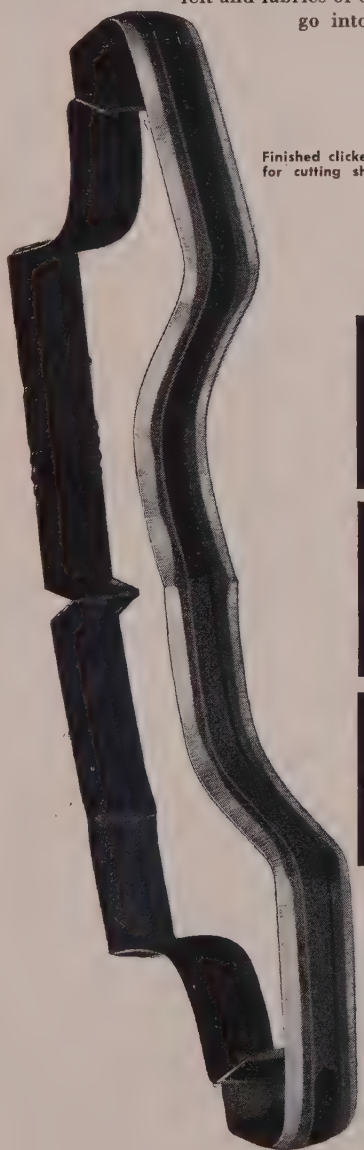
When asked about his hobbies he replied that his spare time was well taken care of by his two daughters, ages five and three.

What's Happening at CRUCIBLE

about clicker die steel

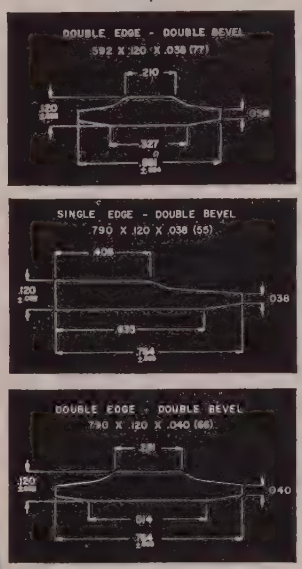
what it is

Clicker die steel is a special cold rolled alloy steel. It is used in making clicker dies for cutting leather, rubber, plastic, felt and fabrics of other compositions that go into the making of shoes and similar products.



Finished clicker die ready for cutting shoe leather.

Some of the clicker die steel standard shapes.



Wider shapes are used when dies are sized by surface grinding after forming and welding. Standard widths are provided when the dies are not to be surface ground.

how it is used

Clicker die steel is furnished to the die maker in either single or double edged form in one of several standard shapes. The die maker first shapes the die by bending the die steel to a pattern that provides the desired configuration, and then welds the two ends at a corner. He finishes the die by grinding a bevel on the outside of the cutting edge and filing the inside edge. Before the finished die is hardened and tempered, the die maker forms identification marks — combinations of circles and squares — in the cutting edge so that the material cut from it may be easily identified as to its size and style.

In the cutting operation, the leather or other material is placed on an oak block in the bed of the clicker machine. Then the die is placed by hand on the material which is cut as the aluminum faced head of the machine presses the die through it. The clicking sound which the head makes as it strikes the die is where the term "clicker machine" derived its name.

what it is composed of

Clicker die steel as produced by the Crucible Steel Company of America is a controlled electric steel in which the combination of carbon and alloy is designed for maximum toughness and proper hardness after heat treatment.

Experience has proved that cold finished clicker die steel is superior to hot rolled material for sizes approximately ¾ inch and narrower because of its lower degree of surface decarburization which permits the use of slightly thinner sections. Cold finished material also has a better surface finish with closer width and thickness tolerances and thinner edges that require less grinding and filing to complete the die.

CRUCIBLE'S engineering service

As with clicker die steel, the Crucible Steel Company of America is the leading producer of special purpose steels. If you have a problem in specialty steels, our staff of field metallurgists with over 50 years experience in fine steel making is available to help you solve it. Crucible Steel Company of America, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

53 years of Fine steelmaking

Midland Works, Midland, Pa. • Spaulding Works, Harrison, N. J. • Park Works, Pittsburgh, Pa. • Spring Works, Pittsburgh, Pa.
National Drawn Works, East Liverpool, Ohio • Sanderson-Halcomb Works, Syracuse, N. Y. • Trent Tube Company, East Troy, Wisconsin

WHAT *is* LIGHT?

by Tom Madden, Gen. E. '54

For centuries the world's prominent scientists have been searching for a solution to one of the greatest mysteries of our universe—the composition of light. Although we make use of this phenomenon during nearly every waking hour, few of us realize the mystery contained in something as common as the glow of an electric light bulb. Specific theories regarding the nature of light are extremely numerous with new ones being presented periodically. Nearly all of these separate theories are, however, variations of one of four basic theories: the wave theory, the electromagnetic theory, the quantum theory, or the combined theory.

Before 1850 light was featured by most scientists as strictly a wave phenomenon. Many experiments have given conclusive evidence of the wave characteristics of light. Three of these experiments have been conducted as follows, using the waves of a body of water as an analogy:

1. When held before a light, a fine wire casts no shadow. This bending of light around a wire is comparable to the following of a water wave around a rock.

2. If a beam of light is passed through a very small hole, it casts a disk of light upon a screen. A careful examination of this disk shows that it is ribbed with dark and light concentric rings. This diffraction characteristic of light is similar to the action of waves as they enter a harbor through a narrow mouth and diverge.

3. Light passed through two pinholes very near each other produces parallel light and dark stripes upon a screen. This effect can be compared with the reinforcement and annulment of water waves as they meet.

These experiments demonstrate three characteristics of light which substantiate the wave theory.

In 1864 Maxwell predicted the existence of electrohagnetic waves. By using electrical data he calculated the velocity these waves should have, which turned out to be the same as the speed of light. Then in 1888 Hertz first produced these electromagnetic waves experimentally and found them to contain some of the same qualities that existed in light; the qualities of speed, reflection, refraction, refraction, and polarization. Continuing his theory, Maxwell predicted that light exerted a force on objects upon which it fell and proceeded to calculate that pressure. The actual experimenting on this prediction was done by Nichols and Hull in the United States and Lebedew in Russia. These scientists proved Maxwell's prediction correct.

Thus, to carry through Maxwell's theory on the composition of light, the vibrating electron within the atom is indicated as the probable source of light. The Zeeman effect (the resolution of spectral lines when the source of light is placed in a strong magnetic field) seems to prove this indication correct by showing that the vibrating source has a negative charge identical to the charge of an electron.

The early Greeks believed light to be composed of thousands of infinitesimally small particles which caused the sensation of light upon striking the eye. This theory was discarded long ago and not heard from again until about 1900 when Max Planck came forth with his quantum theory. At that time Planck was at work in search of an equation which would show that the amount of radiant energy from heated bodies was dependent upon wave length and temperature. He derived the following equation: E=energy, v=frequency of radiation, and h=Planck's constant. (This figure is a fundamental constant in nature.) This equation was satisfactory, however, only if the radiant energy was assumed to be emitted in separate bundles, called quanta, or corpuscles.

It was at this point that Einstein became interested in Planck's work and postulated that the quantum theory pertained to all forms of radiant energy, such as light, X-rays, and heat. Therefore, Einstein reasoned, the sensation of heat is the bombardment of the skin by quanta of heat. Similarly, the sensation of light is a bombardment of the optic nerves by light quanta, with color changes according to the Hd in Planck's equation.

The existence of the quantum theory helped clear up a problem presented by the "photo-electric" effect. The "photo-electric" effect is the ejection of electrons from a metal plate when held in a light. The velocity of these ejected electrons varies with color, but not intensity. Here Einstein said that the light quanta, which he called photons, knocked the electrons from the metal. Consequently, since the photons were supposed to be bundles of energy, the velocity of the ejected electrons should be dependent upon the energy of these photons.

The major weakness of the quantum theory is our complete lack of understanding as to the physical nature of a quantum. Since a complete quantum is necessary to produce the "photo-electric" effect, it would seem possible to measure the length of a quantum by cutting up, i.e. intermittently breaking with a shutter, a light beam until the "photo-electric" effect ceases. At this point the shutter would not be open long enough to permit a whole quantum to pass through, and by computation with the shutter time and the speed of light, the length of a quantum could be calculated. Although a mechanical shutter of such speed is impossible, a crystal immersed in a liquid has been successfully used. With such a device it has been determined that quanta are somewhat less than a few feet in length. Because of the enormous speed of light accurate measurement of a quantum's length is impossible.

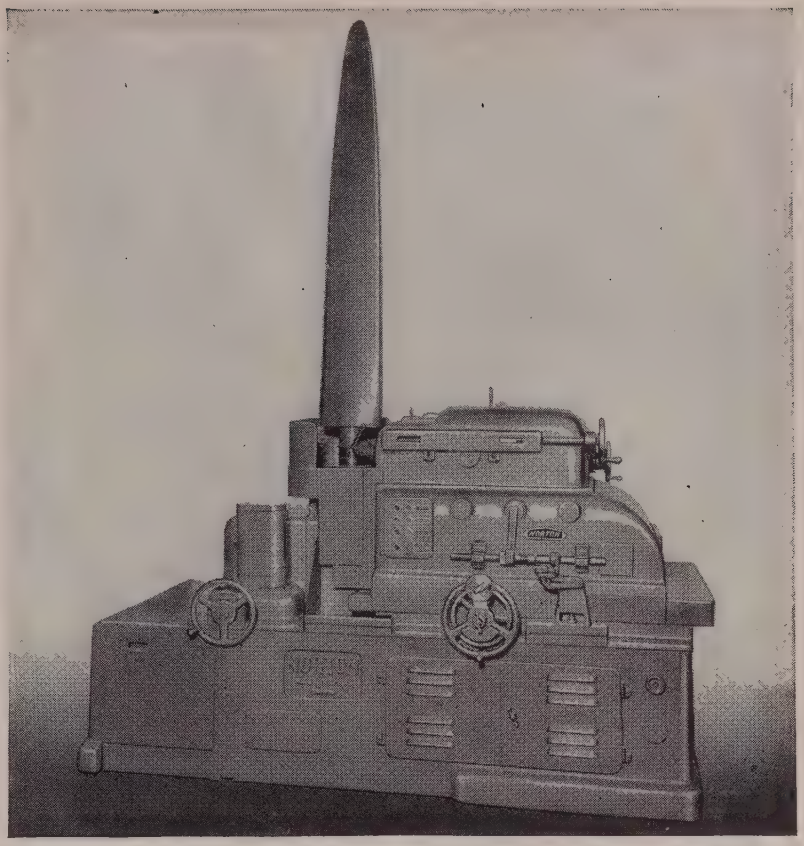
At the present time the most widely acclaimed theory in scientific circles is that light consists of a combination of waves and corpuscles (quanta). The combination theory can best be expressed in the following way, again using water waves as an analogy: Light waves are waves of corpuscles. Just as a water wave crest may be described as a wave crest, a light wave crest may also be described as a crest merely because it contains more light molecules than a trough.

Recent speculation on the combined theory makes use of the fact that just as corpuscles of light show interference rings when directed upon crystals, electrons directed upon similar diffusing agents produce similar interference rings. Because of the similarity of these two phenomena scientists have been led to believe that an electron is a corpuscle and a wave. Hence, matter is waves and corpuscles.

From the past discussion we can readily see that many hours of research are yet to be spent before the scientific world arrives at a definite conclusion about the composition of light. Theories which now exist will undoubtedly give way to new ones, just as the past theories were dropped in favor of the present ones. However, until the final all-inclusive theory of light is formulated and proven, scientists will continue to make use of the present theories in their work with light.

What Is this Machine?

- ☐ *a vertical miller*
- ☐ *a grinding machine*
- ☐ *a broaching machine*
- ☐ *a contour shaper*



It is a grinding machine — specifically, the new Norton Propeller Blade Hub Grinder, used to grind the external surfaces of the hubs of aircraft propeller blades

A Typical Norton Development

This specialized Norton machine brings unusual efficiency to propeller grinding operations. As shown, the propeller blade is held *vertically* — by a workholding fixture on a work spindle with an anti-friction bearing — a new departure that avoids the errors normally caused by deflection when the blade is held *horizontally*, as in conventional methods.

The new Norton grinder has many other improved features adding up to greater speed, accuracy and simplicity of operation. And it requires considerably less floor space than do horizontal machines adapted for the same purpose.

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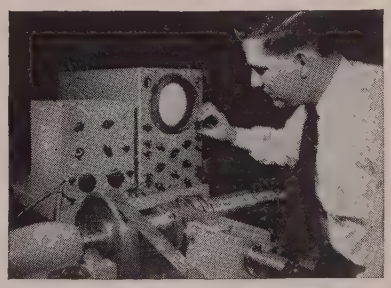
Free Booklet describes and illustrates representative types of Norton grinding and lapping machines. Write for your copy.



Guy D. Metcalf, B. S., E. E., Worcester Polytechnic Institute '49, checks smoothness of master cam spindle with specially designed electronic equipment — in connection with his work on Norton cam and contour grinders.

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TV at the U of I

by Maurice Garnholz, Aero. E. '56

Unobtrusively located down in the interior of the south-west corner of the stadium and built on an old basketball court are the well-laid beginnings of what may be the University of Illinois' top attractor of comments and attention for many months ahead.

This, as you have probably already deduced, is that part of the University known as the University of Illinois Television Studios. With the exception of a few things, nearly all of the equipment used by this organization is situated between the four walls of this rather large room. The control room is walled off into one corner, comprising the only truly partitioned section of the room. In there the master engineer sits in a chair and watches three different television screens—one view of each of the two cameras intermediate "shots" and one master screen, which shows to the control engineer the picture that is being sent over the air (or recorded). An office of a sort is merely a curtained off section of the room. The rest is left open for easy movement of cameras and equipment while telecasting or recording. A ceiling with sound-deadening insulation, a tile floor, a microphone boom, the control room, two television cameras, and lights of various intensities placed in diverse positions constitute the major working parts of the stadium studio. As yet the studio has no transmitter other than a tiny five-hundred milliwatt transmitter.

It is fairly well agreed among the studio personnel and especially by Dick Rider, head of the studio, that sufficient funds have been granted thus far for the studio, which is reasonably well equipped. It exists now as an integral part of the University budget, and is hence subject to state action along with other parts of the University.

The organization holding control of this place, namely, the University of Illinois Television Studios, officially came into existence in July, 1952. It was set up to carry out two principal functions, which were to "shoot" material for films and to be used in the activities, projects, and research that the University deems necessary to engage in. These films are being made and will be made with the idea in mind of using them on future television programs.

The television studios were organized under the able direction and supervision of Wilbur Schram; Dean of Division of Communications, and are presently also under the office of University Broadcasting, of which Robert B. Hudson, Associate Professor of Journalism and Communications, is director. He is responsible largely for consulting with the president on broadcasting matters at hand and on those with which he feels attention is necessary or with which conflict in the future is unavoidable.

Inspection of the microphone boom before a TV show. (Staff photos)

The purpose of the film making, now in process, is two-fold. The first phase, campus filming, takes in the normal functions and activities present on campus, such as the football games, Block I, Spring Carnival, Homecoming, Dad's Day, Mother's Day, etc. The remainder of the celluloids are being made for future use on television.

The long range project of the University as regards television spreads out into three specific areas. To bring to as wide a public as possible as much information and knowledge of the University, and of the knowledge it contains, through television is a very prominent purpose of this television project. To fulfill this purpose it will engage in the production of films to bring to the continuously expanding television audience of the state.

A second category into which the University of Illinois television is subdivided is that of entering into research as regards television and its methods, techniques, styles, etc. But it is necessary to differentiate between the electrical engineering division which does a different and extremely more technical type of research and the research spoken of here. Television research in connection with the studios is concerned with correcting mistakes in camera positions, acting, management, effect, trends, scrips, advertising, etc.

The third area into which the long range conception delves is that of television education. The University will soon offer vocational instruction to those interested in going into television asa career. I will go into this in more detail shortly.

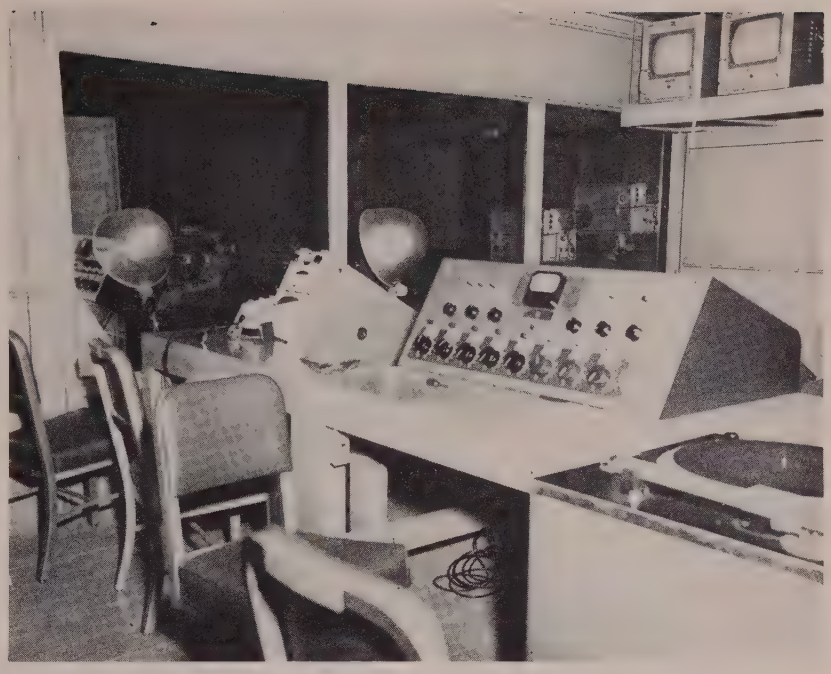
These aforementioned three areas, with possibly the exception of the first, will have been served whether or not the University operates a station in the future. This is evidently true, for research is being currently carried on, while vocational instruction will be given starting within the next few years, according to present plans.

The films for Channel 12 for use in the educational field in the Champaign-Urbana area will be authorized by the Board of Trustees of the University of Illinois. This University television station, Channel 12, will come into existence as a living entity if and when the previously mentioned Board files with the FCC (Federal Communications Commission) and if the two-year budget, particularly that dealing with the section on television, for 1953-1955 is passed in Springfield. Both are expected to be accomplished unless some unforeseen obstacle forces events to change greatly. Even if for some reason the channel is allowed to go by via de-

fault, the Board is still interested in exploring everything to the fullest possible extent now.

Whether the University will operate a station is not known for sure, but whether it does or not, the state will undoubtedly still be covered by a television network in the not too distant future. University television would afford a splendid opportunity to bring the trend of knowledge of the University of Illinois to a sizable portion of the public in the State of Illinois. There were 108 television stations a few months ago, while there will probably be over a thousand in the next few years. It would be an excellent phase of progress to bring the vast storehouse of knowledge and resources available here at the University to a large part of this state, and even to other regions of the country. The depth of this exploration would be profound indeed, and the effect on people, noticed particularly on children, would be very helpful in determining the best kinds of programs to be telecast for educational purposes. Instead of "Dragalong Deadeye" or "Suspenseful," programs of a more educational, but still interesting nature would be shown to the public. Such programs should have a definite effect of good educational value.

There is no direct instruction in television offered as yet this year, although there is a curriculum dealing in television programs now being offered. Also, the School of Journalism offers a program dealing in news and radio, which are very closely related subjects.



General View of the control room of a television station showing the control panel, monitors, and turntable.

The television training to be offered will be comparable to a trade school training, but with an elaborate background and a LAS education, which would tend to border more or less on the management side. This field of instruction also could be compared to an engineering curriculum.

At the present time the University television set up is largely occupied with taking educational films for television release. While the story matter of the movies is compiled in the field and on various parts of the campus, the beginnings, endings, narrations, and music, if any, are all filmed and recorded right at the stadium studio. Present in the films, which are usually either fifteen or thirty minutes long because of their designation for future TV programs, are numerous representations of the various colleges of the University. Among these are the opera workshop of the School of Music, two films on archeology from the Department of Sociology and Anthropology, and the College of Agriculture, of which Home Economics is a branch and a filmed subject. The Department of Entomology may make some films for television soon, the first one being on bees. Subjects of other films already completed have ranged through such varied subjects as music, dance, physical education, and the library.

In the College of Engineering, a film on engineering research—part of a series of films on research at the University *of* Illinois with such subjects as animal science and botany being present—concerning ceramics, materials testing, the railroad brake and wheel laboratory, and other phases of research in the engineering section of the campus has been made. Labeled as the chief problem by the television men in the shooting of films about engineering research is that of tying in the items filmed with those found in everyday life. Simple as

Public inspection of television equipment at the recent Festival of Contemporary Arts.

this may seem to young, aspiring engineers, it is often difficult for the layman and non-engineer to see the relationship between the two.

Another engineering project now ready to be put on film is designed to be shown in high schools throughout Illinois. Shot mostly on the engineering section of campus, it attempts to illustrate the opportunities to be found in the fields of engineering, both now and in the future.

Even *if* the television station is not approved by the State Legislature and consequently *not* built here at the University of Illinois, the films will by no means be wasted. It is hoped that they will be used for their original purposes or at the most, be only slightly warped replicas, and be used for the good of many on other television stations.

An organization, termed the National Distribution Center for television films, has been set up by other colleges for general educational purposes. This will tend to tie many colleges and universities together in a national cooperative venture. When one realizes the near impossibility of a station's originating, organizing, and televising its own programs, he can see that the NDC is a very good idea. Because of it, no one school will have to do as much work as it would have to do otherwise. Pooling the talents and top films of the country's educational institutions together will consequently help each university and college to have a better television station with a much better selection and quality of programs.

One of the features that has been attracting the most attention during the past few months is the televising of Illini basketball games. WGN radio station of Chicago does the actual televising of each game, while the University studio merely hooks up to WGN's transmitter and sends the picture obtained to the television theatre audience, which is also located in the stadium.

Football games and probably all other events of major interest and importance are planned telecasts of the future. As to how soon the University will have its own complete station and begin these TV broadcasts and educational programs is anybody's guess, but when it happens another rung on the ladder of progress will have been reached.

The most difficult part of getting to the top of the ladder is getting through the crowd at the bottom.

—Journeyman Barber

* * *

No man lives in vain who is important to the life of someone else.

If a man removes his hat in an elevator, he has one of two things — good manners or hair.

* * *

Life is a grindstone, and whether it grinds a man down or polishes him depends solely upon him.

* * *

The way to love anything is to realize it might be lost.

* * *

Falsehoods not only disagree with truths, but usually quarrel among themselves.

—Daniel Webster

* * *

There is nothing like self-support to bring on self-respect.

* * *

Sooner or later the man with a pull loses out to the man with a push.

* * *

Don't waste any time weeping because you are not a genius. John Orr Young, co-founder of that big advertising agency, Young & Rubicam, says, "The most competent people I have encountered have been fairly plain folk, given to an earnest pursuit of their special duties. I have observed more successes resulting from hard work than from spectacular genius."

—Nashua Cavalier

How to lick dust, moisture and acid fog

prevalent in the atmosphere surrounding the Rumford, Me., mill of the Oxford Paper Company posed a problem in power circuit maintenance. The combination of these elements caused wooden structures and even over-voltage insulators to become conducting, resulting in phase-to-phase flashovers and burndowns when ordinary overhead wires were used.

The solution of this serious problem was found by substituting Okolite-Okoprene Self-Supporting Aerial Cable for the open wires. According to company officials, the combination of Okolite high voltage moisture and heat resisting insulation, protected by non-conducting weather and chemical resistant Okoprene sheathing, has eliminated this trouble.

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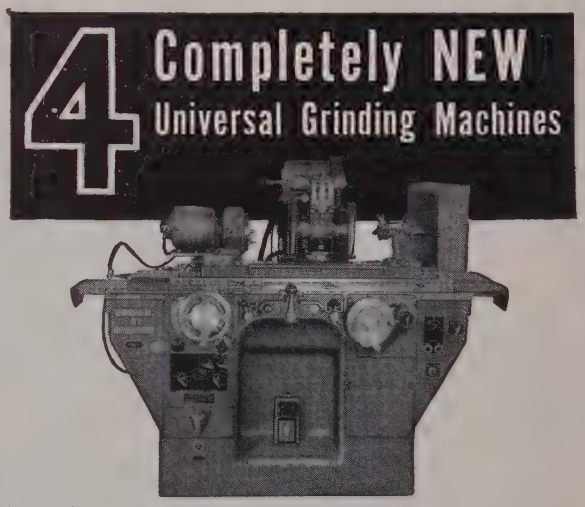

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Toledo's Water Pressure Rises and Falls with Popularity of TV Programs

(Reprinted from the Toledo Blade)

by Alan F. Schoedel, Staff Writer, Toledo Blade

Worker's Blood Pressure Shot Up Until Cause Was Found; Sure-Fire Formula Worked Out To Rate Shows

Radio has its Hooper Ratings, Hollywood has its box-office polls, but if the television industry wants to keep tabs on the popularity of its programs, let it consult the Toledo waterworks.

George J. Van Dorp, water commissioner, claims he can measure the appeal of a TV show by means of the fluctuations he has found in the water pressure during the evening. The pressure remains high during a television program, while everybody is sitting quietly watching, but suddenly drops at the end of a program because—guess what—so many persons get up and go to the bathroom at the same time.

Back in 1951, the water department began to be troubled seriously by sharp, sudden and unexplainable variations in the demand for water during an evening.

Consumption would fall off to an unusually low level for a while and then, in three or four minutes, it would zoom upward. Pressure in the mains would fall accordingly.

When this happened, the alarmed and puzzled crew at the Collins Park pumping station would throw another big pump into action. Minutes later the use of water would unaccountably drop below normal again, and the extra racing turbine would have to be turned off.

By summer of 1952, the trouble had become acute. It was costly in wear and tear on water department equipment, nerve-wracking for the pumping station crews.

Complaints of low pressure were received frequently from industrial plants. The flow of water to cool such machinery as metal presses or die-casting equipment, or for use in air-conditioning would suddenly go down to a comparative trickle.

Mr. Van Dorp assigned two investigators to find the source of the trouble. Were some big industrial plants, perhaps, using great quantities of water on an erratic schedule?

Armed with gauges, the trouble-shooters tested pressure in mains throughout the city. The fluctuations were there, all right, but they seemed to be everywhere in the system. The cause just couldn't be localized.

Baffled, they went back to Mr. Van Dorp's office with their findings. Further check of the records showed one thing. The ups and downs occurred at intervals of a half-hour or hour.

Truth dawned on the water officials.

"We had found the culprit at last," Mr. Van Dorp related. "It was television."

What happened was that families all over Toledo would stay close to their television sets while a good program was on. When it ended and the between-program commercials came on, they would get drinks or give the last of the dinner dishes a hasty scrubbing before the next show. But the largest use unquestionably, Mr. Van Dorp says, is that of bathroom facilities which use an average of eight gallons for each operation.

For example, at the start of "I Love Lucy" — top program on TV by the Van Dorp rating system—one night recently, the rate of water consumption went down 13.8 per cent from the normal pumpage line. In the space of about five minutes when the program ended, it shot up 22 per cent over the low, showing a brief net gain in use of 8.2 per cent.

On another night, pressure in the water mains in Point Place—hardest hit by these fluctuations—dropped 30 per cent in a matter of minutes because so much water was being used.

"In the past, when a pressure drop like that occurred, we would send out an emergency crew to see if a 12-inch main, or even a larger one, had burst," said Mr. Van Dorp.

At the Collins park pumping station, a needle moving over a slowly rotating disc traces throughout the day the rate, in millions of gallons, at which water is being pumped to keep the mains full. It shows with fascinating accuracy the public reaction to a program, right down to the commercials.

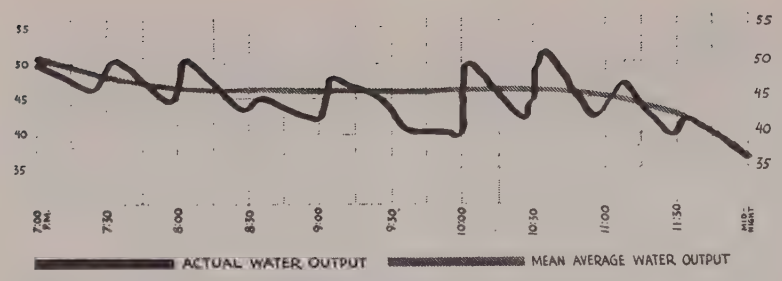
For example, on a recent TV "fight night" the gallonage dropped off at 10 p.m. when the boxing bout began, but spurted upward when the fight ended, well before 11 p.m., instead of on the hour.

Water consumption was generally low during the hour-long drama telecast on Sunday night, Jan. 18, between 1 and 10.

But about 9:20 it rose 6.5 per cent for just a couple of minutes. About 9:40 there was a similar brief upward swing of 10.5 per cent.

"Those are the commercials," Mr. Van Dorp explained. "People left their sets while the commercials were on and used water in various ways."

The same sort of evidence convinced



GRAPH SHOWS HOW WATER USE FLUCTUATES IN TYPICAL EVENING

Good show from 9:30 to 10, wasn't it? Figures at left and right indicate pumpage rate in terms of millions of gallons per day

the water commissioner that Ed Sullivan's show, "Toast of the Town," is a "slow starter" because of the rather lengthy commercial at the beginning.

Water use drops off slowly at the start of this program, and Mr. Van Dorp attributes this to the fact that people know there is going to be a long introductory announcement and advertising talk, just as they know that if they miss the first act of such a variety show it won't affect the continuity for them. By contrast, a show like "I Love Lucy" demands—and gets immediate attention right from the start.

The men at the pumping station get a laugh out of those pressure changes now," Mr. Van Dorp said.

"They know what shows are coming up on TV, and they can tell in advance what's going to happen. They know the abnormal demand will last only a few minutes, so they don't turn on one of the extra pumps.

"We still get some complaints about pressure, of course, but there's nothing we can do we just tell the people what the reason is. We used to be worried over whether we were negligent in some way that we couldn't understand."

Using the data available from the department charts, Mr. Van Dorp worked out his rating of TV shows.

Like the true pollster, concerned with medians and weighted averages and variable factors, Mr. Van Dorp has devised a formula which can be applied by waterworks engineers in other cities with the same problem to give ratings to TV programs affecting pressure. His formula checks "Program Popularity through Pumpage and Pressure," which Mr. Van Dorp has shortened to "P Rating."

He recognizes that in Toledo the formula is simplified because there is only one television station here. He also makes allowance for the fact that the proportion of water going to private homes rather than industry varies in different cities—and that's important to the rating.

Supporting Mr. Van Dorp's theory is the experience of the Detroit superintendent of water, L. G. Lenhart. He said that any popular show or special event that would attract attention to television or radio caused a "terrific bump" in the pumping rate.

His department, he said, had drawn up its own charts showing relative popularity of events and shows.

That this is the first time the theory has been expressed publicly was confirmed by W. A. Hardenbergh, one of the editors of *Public Works Magazine* in New York. He had first heard of the explanation, he said, from Mr. Van Dorp at a meeting of waterworks technicians in Cleveland. A paper of Mr. Van Dorp's was published on the water use fluctuation in the magazine's March issue, he said.

Just one thing, Mr. Taxpayer, Mr. Van Dorp wants it known that he worked out the formula on his own time.

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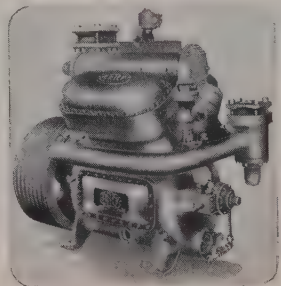

Frick "ECLIPSE" Compressors Handle Air Conditioning Work with Extra Economy: ask for details.

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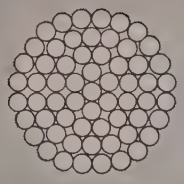
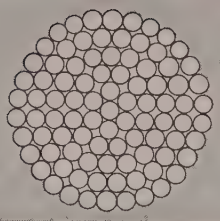


61 strand Concentric Stranding



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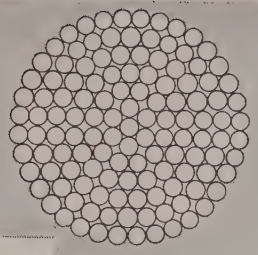

127 strand Concentric Stranding

is the area of a circle whose diameter is one mil, 0.001 inch. The area of a circular mil is $\pi/4$ or 0.7854 of a square mil. The unit of length usually associated with this unit is the foot and the resistance becomes ohms per CM-foot. The resistance of annealed copper and aluminum per circular mil-foot at 20C are 10.371 and 17.011 ohms respectively. The resistance of a copper conductor 64 mils in diameter and one foot long thus becomes $10.371 \div 64^2$ or 0.00253 ohms.

The sizes of electrical conductors *are expressed in the United States in terms of the American Wire Gauge. This was originally set up on the basis of a geometrical progression of 39 steps or sizes between a wire 460 mils in diameter (Size 4/0) and a wire 5 mils in diameter (Size 36). The ratio of the diameter of a wire to that of the next larger size in this series is 39 $\sqrt{460/5}=1.12293$. This ratio has since been used to extend the American Wire Gauge (AWG) to sizes smaller than 36 AWG (5 mils). The sizes of conductors larger than 4/0 are expressed in circular mil area. The size of a conductor made up of a number of wires is determined from the sum of the circular mil areas of the individual wires.*

When current flows through a conductor there is, according to Ohm's law, a voltage drop of $E = IR$, where E is in volts, I is in amperes and R is in ohms along the conductor and power equal to EI watts is converted to heat. Since $E=IR$, this power converted to heat becomes I^2R watts. These two factors, voltage drop and conductor heating, are of prime importance in the design of conductors. Conductors must be sufficiently large in cross-sectional area, that is, must have sufficient low resistance that the voltage drop does not become excessive. In good design this voltage drop should not exceed 3 per cent for power circuits or 1 per cent for lighting circuits. The conductors should also be large enough that their temperature does not exceed that for which their insulation is designed. This is referred to as the current carrying capacity of conductors. The current carrying capacities of the various sizes of conductors, conductor insulations and installation conditions have been established. It should be noted that the temperature attained by a conductor depends not only on the amount of heat generated but also on the thermal resistance of its surroundings.

In addition to providing satisfactory voltage drop and current carrying capacity, conductors must be designed to provide adequate flexibility during installation and service. This is accomplished by building up the conductor from one or more adequately small wires depending on the flexibility required. For example, the conductor for heater cord or welding cable which is subject to repeated flexing in service is usually made up of copper strands having a diameter of .005" or .0063" while the conductor for overhead weatherproof cable may be a single wire.

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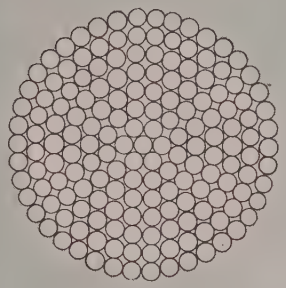

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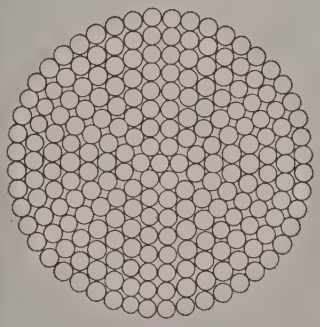

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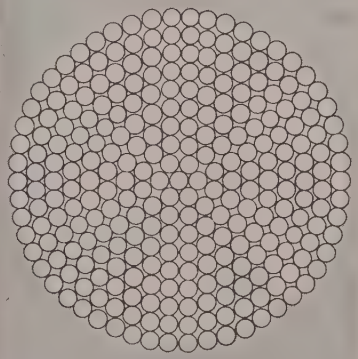


271 strand Concentric Stranding

Rope Stranding

Bunched Stranding

The Honorable Herbert Hoover was invited by ECMA Chairman Paustian to write a message to student engineers for simultaneous publication in all member magazines of ECMA. Mr. Hoover offered the following:

simultaneous ECMA article . . .

The Engineers Can Help Save Our National Life

by the Honorable Herbert Hoover

(Reprint of an Address delivered to the Northwest Engineering Centennial)

This is not a political treatise. My first text comes from the agreement of both political platforms that the nation is mired down in a swamp of spending, inflation, and taxes. Both parties disagree on who-done-it. They seem to agree upon the obvious that reduction of Federal expenditures would be a good step to get out of the swamp but there is wide disagreement on where to begin and how much.

However, I am suggesting something else which is a partial method of relief, and that is where the engineers come in. That partial remedy for our ills is with all our might to stimulate scientific discovery, invention and their application by our engineers. That would increase productivity per capita and thereby mitigate these burdens. I do not guarantee it can work fast enough to save the American way of life but it could help.

The basis of this hope lies in our experience from three great hot wars. By increased productivity after these wars the credit of our nation was restored and the prosperity of our people moved into high levels. That was true after the War of the Revolution, the Civil War, and the First World War. But this extension of the Second World War into six years of cold war is where my belief comes from, that this is now only a partial remedy. Otherwise a continuation of these spending, taxing and inflation policies can have but one result. That is a national socialistic state.

After the War of the Revolution free initiative in expansion of our agriculture and the application of steam power in the factories increased our productivity, restored our national credit and gave a great lift to the standard of living.

After the Civil War the expansion of the railways brought millions of new fertile acres into productivity. With this, and with growing skills in free industry the nation again recovered and marched forward.

After World War I, scientific discoveries and inventions, and still more growth of skills and improved processes found expression in the expansion of motor transport and electrification, radio and airplanes. And from cheaper costs of production we remedied the ravages of war and rose to the highest average standard of living in all human history.

Since the Second World War we have again made great advances in science and invention. We have built many improved plants but we have not yet been able to catch up with the spenders and the tax-collectors.

One warrant for my hope lies in the fact that we, with only six percent of the world's population, have today more trained scientists and engineers than all the rest of the world put together.

The application of new scientific discoveries and new inventions is always a business speculation. It is based on venture capital and plowing in of profits until production is in full bloom.

There are two obstructions in the path of such a solution of our economic problems. The first is unintelligent taxation and the second a coming national famine in technologists. I could enumerate a dozen other destructors but I said this would not be a p o l i t i c a l treatise.

An Example

There is no better exhibit of what ill-considered taxation can do to our economy than our non-ferrous metal industry in the West. That industry is founded wholly on venture capital and the plowing in of profits until a mine is equipped and producing. Today such venture capital from individuals is itself undermined, and taxation prevents the n e c e s s a r y plowing in. That is not theory; it is a fact. Twenty years ago there were about 3,000 operating nonferrous metal mines in the Rocky Mountain area. Today there are only a few more than 1,000. I recently made a canvass of the operators of many of the large mines which were developed in a more favorable economic climate. I asked a simple question—Could this enterprise have ever been developed and equipped under present taxation and other restrictions on freedom? The answer was NO in every case but one, and that case had been a bonanza so rich as to defy even the tax-collector. But today even in most of these surviving enterprises the government takes from the stockholder about $85 out of every $100, earned before taxes, and if he received the remaining $15, there would be no fund left to plow into constantly needed improvements to treat decreasing grades of ore.

From it all, the nation is becoming short of these domestically produced metals.

By stimulated scientific research and invention looking to new engineering methods we can reduce costs and thus do something to aid this industry. But more intelligent taxes on mines such as those in other countries would sustain the industry. It would be cheaper than government subsidies.

The same problems apply to the other industries where venture capital and plowing in are their characteristics.

But there has arisen an alternative application of new ideas which bodes little good to our society. The established industries can and do undertake such risks in their fields. They can write off their losses against taxes, and the venture costs nothing. The inventor, the prospector or the individual has little chance of this relief. The consequence is that existing enterprises absorb the new discoveries and inventions. They grow in size and monopolistic strength but the opportunity for the individual to establish his independent and competitive business is greatly diminished.

We Are Running Short of Engineers

We have in our profession another great national problem. We do not have enough engineers in incubation to carry on the nation's work. We need 60,000 new technologists a year to supply national needs. Our engineering

graduates have dropped from 50,000 in 1950 to 38,000 in 1951, and the students in training indicate less than 30,000 next year. Yet our universities have ample facilities to fill the demand.

One reason for this drop is that a young mechanic with three years of training, during which he is paid, can earn more take-home pay after taxes than a young engineer with six years of training and three years more of experience. Too often the financing of engineering training is too expensive for his dad. And with increased tuition and living costs it is more and more difficult for boys by off-time work to make their way through college as many of you did.

The answer must come from the industries. They must consider their responsibility to aid promising boys. For it is upon such boys that future existence of industry depends.

The Engineering Profession

But there are more cheerful subjects for discussion among engineers. I have reviewed them many times in the past.

Within a little more than my lifetime, the training of engineers has risen from apprenticeship to a trade or secondary technical schools to the dignity of a university-trained profession.

As indicative of the distance the engineers have risen in public repute, I might recall that some years ago while crossing the Atlantic, I took my meals at the same table with a cultivated English lady. As we came into New York harbor, at breakfast she said: "I hope you will forgive my dreadful curiosity, but I should like awfully to know what is your profession." I said that I was an engineer. Her involuntary exclamation was: "Why, I thought you were a gentleman."

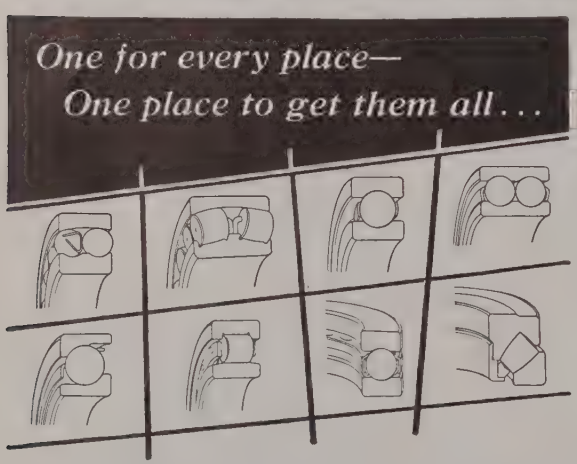
The engineer has a high privilege among professions. He has the fascination of watching a figment of his imagination emerge with the aid of science to a plan on paper. Then it moves to realization in cement, metal or energy. Then it adds to the security and comfort of homes.

Engineering training by our universities has other great values to the country than its industrial consequences. It instills character in those who would join its ranks, for high ethical standards are the essential of all professions. Technology without intellectual honesty does not work. Construction without conscientiousness soon c r u m b l e s. Here is the invocation of veracity in a world sodden with intellectual dishonesty. These are the reasons you have seen no engineers before the Kefauver Committee. Nor in the headlines which t h e s e days pour forth from Grand Juries and District Attorneys' offices. The engineers' main appearance in public is only sit on juries and committees for reform.

From the work of the engineers comes the lifting of men's minds beyond the depressing incidents of the day. And here is the rejuvenation of spirit and confidence in the future of our country.

In any event you will agree that the engineer is an antidote to evil and the bearer of blessings. Even including his antidote to inflation.

In closing, let me repeat a statement from a good engineer of just exactly four hundred years ago. He referred to the mining engineers but his general tolerance is warranty for its applications to all engineers. "Inasmuch as the chief callings are those of the moneylender, the soldier, the merchant, the farmer, and miner, I say, inasmuch as usury is odious, while the spoil cruelly captured from the possessions of the people innocent of wrong is wicked in the sight of God and man and inasmuch as the calling of the miner excels in honor and dignity that of the merchant trading for lucre, while it is not less noble though far more profitable than agriculture, who can fail to realize that it is a calling of peculiar dignity?"



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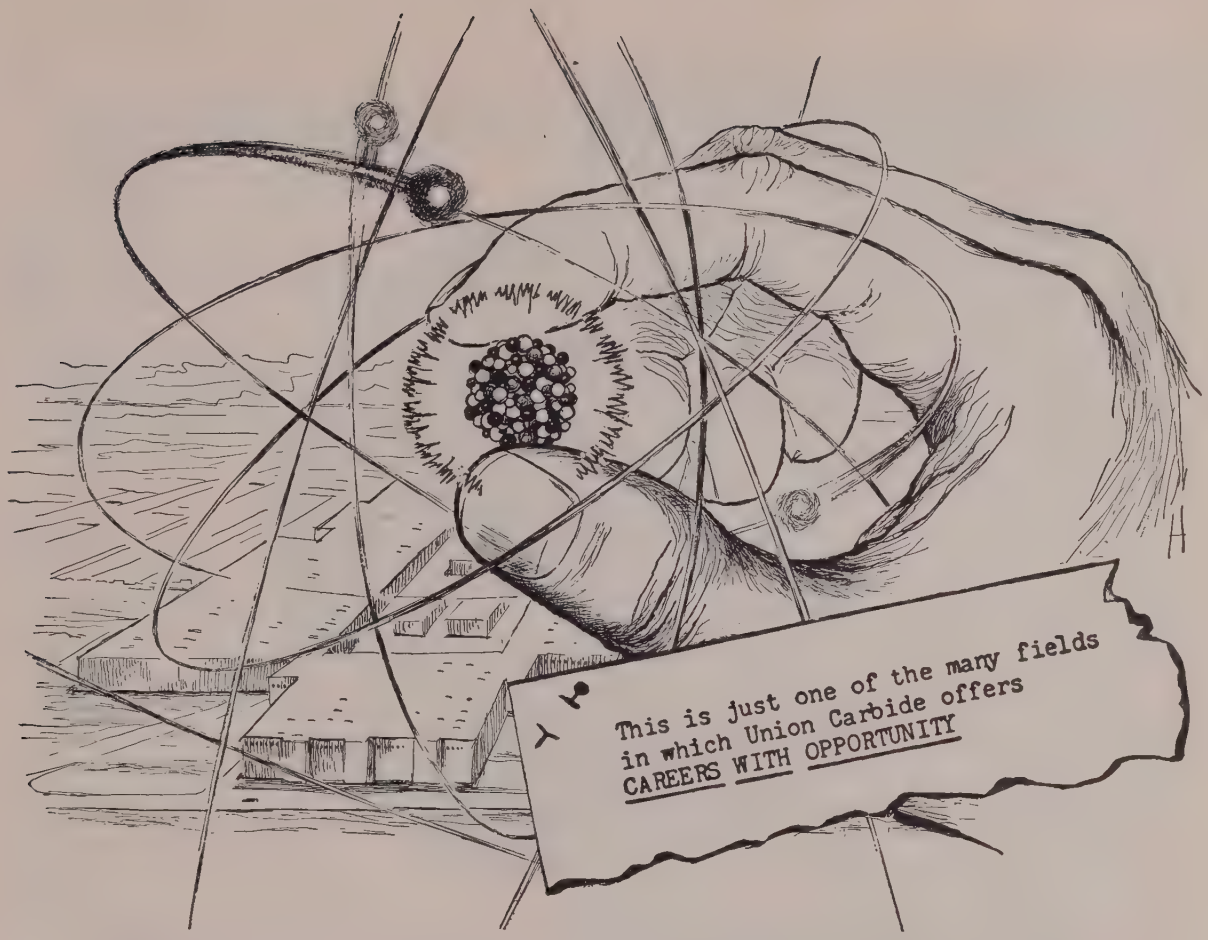

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When these chemicals are made radioactive their paths can be traced through plants and animals, showing the organs they affect. This may increase our understanding of the processes of life itself.

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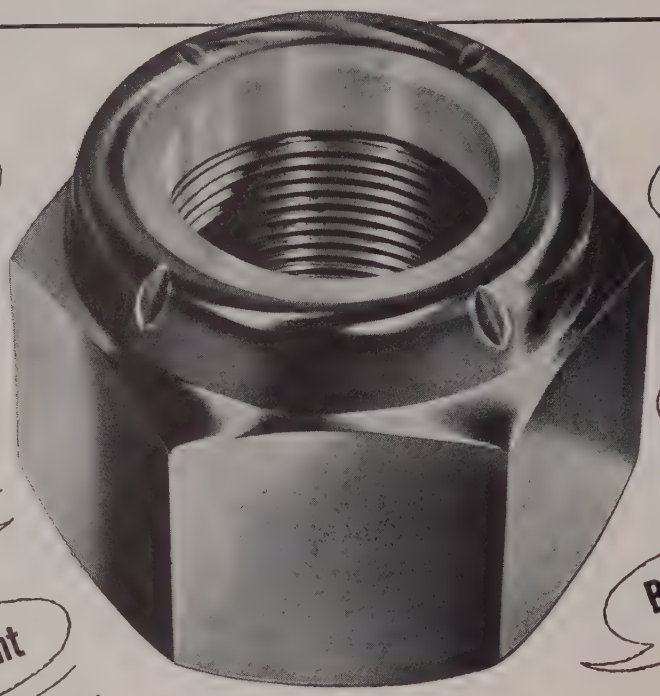

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Oil Seepage

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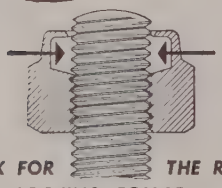

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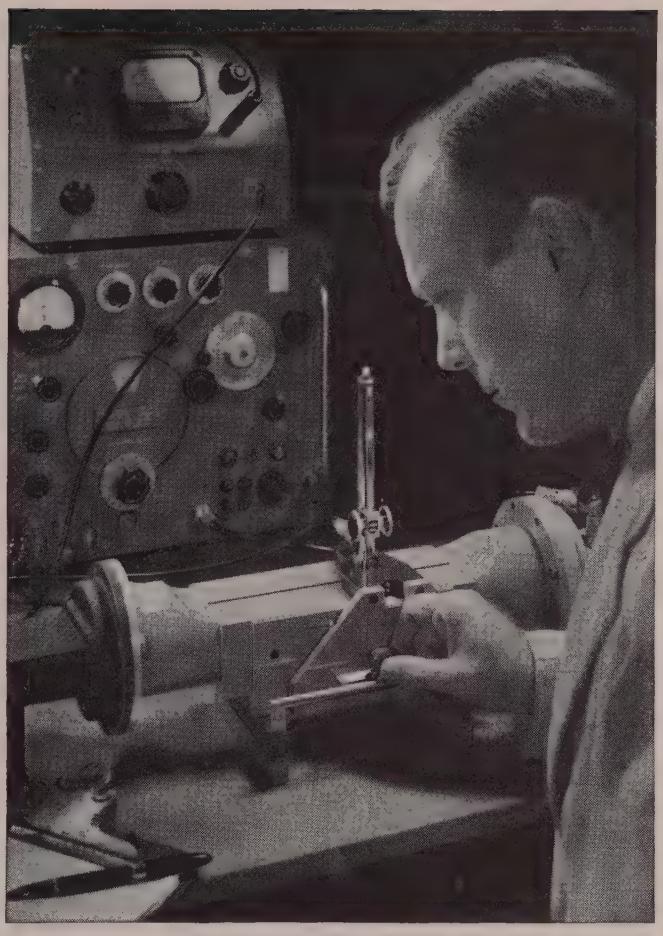

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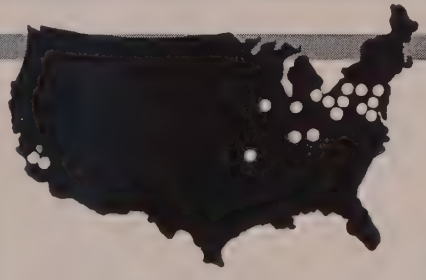

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The Television Camera

by Paul LaViolette, E.E. '56

Among the many complex marvels that the television industry of today offers, perhaps the most amazing is the eyes of the television system—the television camera. The present day television camera is the outgrowth of years of experimentation.

It was in 1873 that a telegraph operator named May noticed that some resisters he was using made of the element selenium actually changed their resistance value when exposed to sunlight. This was the first evidence recorded of an action which later became known as the photo-electric effect.

For years after this many scientists speculated and experimented with selenium in the hopes of using it to transmit scenes from one place to another. In 1877, Senlecq proposed a rather crude scheme for television by using a type of "mosaic." Those sections of the mosaic on which light fell allowed current flow and those sections without light allowed none, thereby forming electrical current very roughly equivalent to the image. Soon after this in 1884, a German named Nipkow came forth with a scanning disc composed of a series of holes that made but one complete circle on the disc and at the end of the one turn one end was an inch closer to the center. The disc was rotated and the rays of light passed through the holes into the mosaic screen generating varying currents due to the density of light. The gradually diminishing radius of the holes caused the entire surface of the mosaic to be covered in one revolution.

This method, although ingenious, had many difficulties: the focal point of the light on the mosaic was too large, there were too few holes in the disc to cover the mosaic equally, and synchronizing the receiver discs permanently was almost impossible.

It wasn't until early in the thirties that the mechanical system was abandoned completely and a faster, more efficient electronic one introduced. The cathode ray tube, the basis of the new method had been suggested for use in television as early as 1911; but as there was no way of amplifying its generated weak signal, the whole method had been shelved and forgotten until DeForest perfected his amplifier vacuum tubes. With the cathode ray tubes it was possible to increase the scanning lines from sixty lines at twenty "frames" (pictures) per second to 525 lines at 30 frames per second. Since lines have a great deal to do with the clearness of the picture, as will be explained later on, this alone would have been sufficient to make obsolete the older method.

The Cathode Ray Tube

The cathode ray tube is simply an electron gun that fires a small thin stream of electrons from one end of the tube to a screen on the other end which fluoresces under the impact of the electrons. This stream of electrons is capable of being deflected by a magnetic field and by setting up two such fields —a North and South and an East and West—the beam can be directed to any part of the screen. After removal of the electron stream to another part of the screen the spot hit by the electron retains its fluorescence for a brief period.

If the pictures in this magazine were examined with a magnifying glass it would be noted that they are composed of neat little rows of minute dots varying in density depending on whether that section of the picture is light or dark, the number of lines determining the clearness of the picture. By applying a "saw tooth" voltage on the line (East-West) field coils and a regular 60 cycle sine voltage on the frame (North-South) field coils, the screen can be covered or "scanned" just like reading a printed page. The resulting picture would be much like the ones in this magazine varying in density only to indicate light or dark. As the frame changes thirty times a second, action can be simulated by the succession of slightly different pictures on the screen much in the manner of a motion picture.

The Iconoscope

The Iconoscope developed by V. K. Zworykin for RCA is a modified version of the cathode ray tube. The tube is as pictured in Figure 2. Light enters the tube through a glass plate and strikes the mosaic plate. The mosaic is composed of several thin sheets of mica. On the front of the sheets are millions of tiny globules of cesium silver oxide. The back of the mica is coated with colloidal graphite which is the signal plate and is connected directly to an amplifier on the outside.

Each silver globule is insulated from its neighbor by mica and has a diameter of about 0.001 inch. Light hitting the silver globule (which is photo-sensitive) causes it to emit its electrons in a ratio directly proportional to the incident light and thereby assumes a positive charge. All the globules react according to the light imposed upon them and an electrical charge is imposed on the plate equal to the image projected on it.

Off to one side well clear of the incoming light is the cathode ray tube without its sensitive screen. The electrons fired from the gun now fall on the positively charged globules of silver

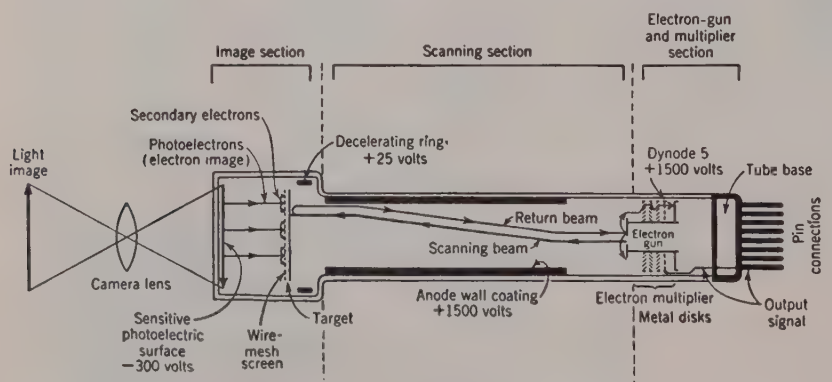

Figure 1. Image orthicon. (Cut courtesy McGraw-Hill Book Co., Basic Television-Principles and Servicing by Bernard Grob, 1949)

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Boeing engineering activity is concentrated at Seattle in the Pacific Northwest, and Wichita in the Midwest. These communities offer fine fishing, hunting, golf, boating and other recreational facilities. Both are fresh, modern cities with fine residential sections and shopping districts, and schools of higher learning where engineers can study for advanced degrees.

There are openings in ALL branches of engineering (mechanical, civil, electrical, aeronautical, and related fields), for **DESIGN, DEVELOPMENT, PRODUCTION, RESEARCH and TOOLING.** Also for servomechanism and electronics designers and analysts, and physicists and mathematicians with advanced degrees.

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salt. The electrons being negative are gathered as needed by the silver and the resulting condenser action with the graphite causes an impulse signal which is immediately relayed to the amplifier. From there it is magnified and sent out as a strong electrical interpretation of the image.

The Image Orthicon

The Image Orthicon also developed by RCA is a refinement of the Iconoscope (Figure 1). Besides the advantage of being more compact, it has the electronic advantage of needing less light and is not liable to "shading" caused by secondary emmission in the mosaic. The need for less light gives this tube a greater range of uses over the old type.

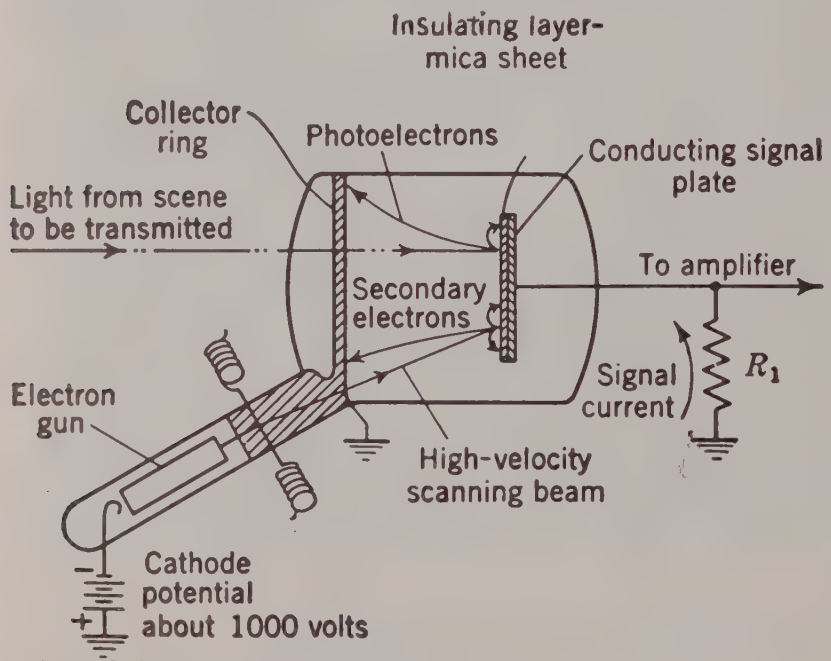

Figure 2. Iconoscope. (Cut courtesy McGraw-Hill Book Co., Basic Television-Principles and Servicing by Bernard Grob, 1949)

The camera shown on these pages is an RCA TK11A which employs the Image Orthicon and is adaptable for both field and studio use.

The Lens

The lenses used on the television camera are ordinary camera lenses with the exception of the Zoomar Lens. The Zoomar eliminates the switching of one lens to another as the object being televised makes rapid changes in range. The lenses are all fixed on a rotary drum that is controlled in the rear of the camera by a handle. The Orthicon tube is brought into focus by moving it back and forth on a sliding carriage mounted to the chassis. The slide is easily moved by a focus handle on the outside of the camera.

To facilitate better framing and as a necessity for quick focusing, each camera has its own viewer which is a small television screen in front of the operator mounted in a removable section on top of the television camera. By watching the viewer the operator always has a clear picture of the image he is transmitting.

The Camera in Action

The T.V. camera on taking a picture transmits the image to controllers in the control unit, where all the remote control operations of shading, aligning and directing take place. The Switcher is the director who takes from the several cameras the image that is the most satisfactory and puts it on the monitor. Here it is double watched for faults and relayed to the transmitter for broadcast by micro-wave link or co-axial cable.

The television camera in the studio is an easier affair to operate than in the field. Here it is moved on dollies and the signal is transmitted to control rooms of comfortable operating size. In the field, however, the heavy equipment is mounted on tripods and the switching and monitoring is done in tight-fitting, uncomfortable trucks. Also there is the difficulty of getting the signal back to the studios to be re-beamed to the transmitters for broadcast. This last difficulty is overcome by micro-wave links mounted on top of trucks or telephone cables connected directly with the studio. As it is set up now, until a more remote wireless method of transmitting can be perfected, the field unit is tied overclosely to the studio.

S.A.E. DEBATE

by Tom Madden
Gen. E. '54

At their monthly meeting on March 23 the Central Illinois Section of the Society of Automotive Engineers had a very interesting and quite different type of program. It was a debate in which a team composed of SAE members from the Illinois chapter met a similar team from Bradley University on the question *Resolved: That hydraulic torque converters are an essential component of future power transmissions.* Each debate team participating in this annual event, held this year for the third time, was composed of five members plus an alternate. Three of them gave five-minute constructives and the other two presented three-minute rebuttals.

The men participating were all mechanical engineering students active in school activities. Ronald Goe, present chairman of the local SAE chapter, was the only debater making the trip who was on last year's squad. The group was accompanied by Professor John C. Miles as faculty advisor. Preparation for the debate was made at about ten weekly meetings held in the Mechanical Engineering Building Lounge.

This year the Illinois chapter defended the negative side of the debate question concerning hydraulic torque converters. Arguments used by the Illini in supporting the manual transmission as contrasted to the hydraulic converter were economy, simplicity, and compactness. On the other hand, Bradley, in supporting the hydraulic mechanism, argued smooth operation, easy to drive, and more time to drive (no need for removing hands from the steering wheel to shift.

The men making the trip are always justly rewarded for their efforts. Last year they all received offers of employment—along with a very hearty meal. The TECH commends these men for their work in the advancement of engineering knowledge, and hopes they may win many more plaques such as the one now adorning the west wall of the Mechanical Engineering Lounge.

You can't hold a man down without staying down with him.

—*Booker T. Washington*

* * *

An apology is better than an explanation—and quicker.

—*William Feather*

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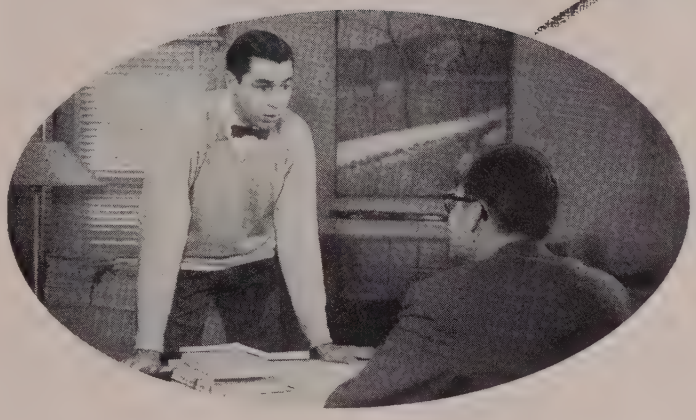

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OIL IN THE BASIN

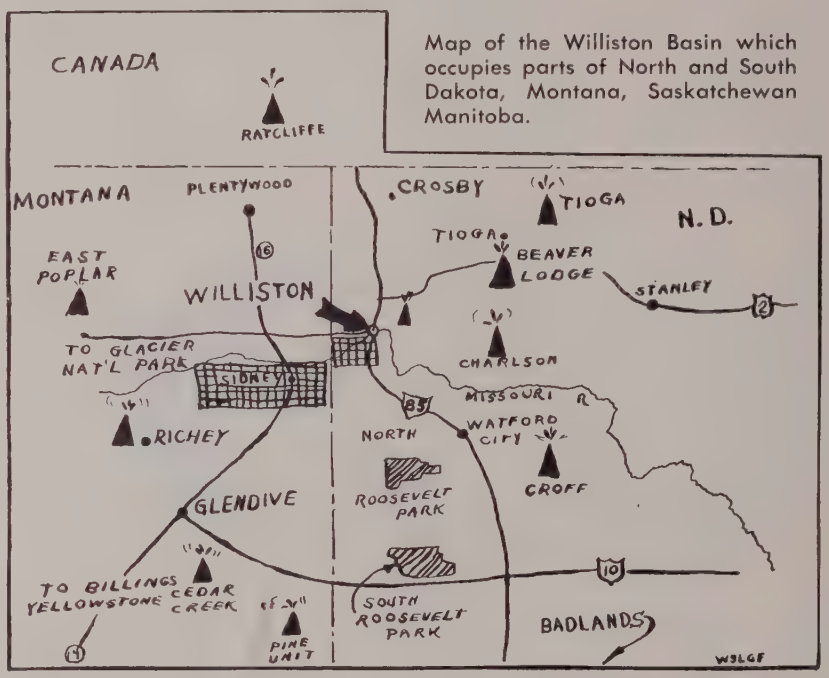
by Daniel J. McGowan, I.E. '55

Each discovery of a technical frontier has been accompanied by tremendous opportunities ever since man began to discover such frontiers. And equally true is the fact that few people recognize the value of a discovery when it is made. This article is intended to present you with information on a recent discovery, and it is your author's desire that you exploit it fully.

Geography books describe the great plains states as sparsely populated farm lands. The people who live there depend upon the whims of weather for their existence. In times of drouth those acres become arid miles of burned wheat and suffocated flax. In winter they are buffeted by high winds and extreme temperatures and are buried annually by tons of snow. And yet there is something worthy of that area, for below the sometimes seared farmlands is one of the greatest oil fields in the world!

The region is called Williston Basin because it centers upon Williston, North Dakota, (in the northwest corner of the state). Geologically, the Williston Basin is a huge underground structural depression, occupying the western two-thirds of North Dakota, overlapping into eastern Montana and parts of South Dakota and stretching into Saskatchewan and Manitoba. The depression is mainly of the Cretaceous system overlain by strata of Tertiary system carrying numerous lignite seams. (See accompanying table.)

Less than three years ago it was only suspected that gas and oil in commercial quantities could be found in Williston Basin. Today that neighborhood is being converted into a major producer of petroleum. Three years of work changed a general area into a place on the map with more than 174 producing wells and 20 new oil fields.



Map of the Williston Basin which occupies parts of North and South Dakota, Montana, Saskatchewan Manitoba.

SYSTEM	SERIES	FORMATION	THICKNESS (feet)	CHARACTER
Cretaceous	Montana	Fox Hills Sandstone	85- 200	Yellow sandstone with marine shells
		Pierre Shale	1070-1950	Blue shale with marine shells
Tertiary	Eocene	White River	40- 400	Coarse sandstone with pebbles and clay
		Lance	700- 900	Cannonball and fresh water limestone

A segment of the table prepared by Arthur Leonard for the *Quarterly Review* of the University of North Dakota. It presents geological information on part of the Williston Basin, where oil was discovered in July of 1951.

The first well was brought in July 13, 1951, in a barnyard by the Amerada Petroleum Corporation. This event flashed a signal to the entire oil industry and within hours the streets of Williston were crowded with wildcatters, lease buyers and those who wanted to "get in on the ground". Within days thousands of acres of land were under oil and mineral lease to petroleum's leaders. Oil boom fever indeed ran high.

What followed in later months is recorded in the journals of industry. Prices of stocks in oil soared and even Wall Street held its breath at the turn of events. Capital, labor and technical ability poured into the area and more oil gushed out.

Total production in the state of North Dakota alone for the period from January 1, 1952 to November 30, 1952, amounted to 1,249,094 barrels of oil. 1951 was a year of discovery; 1952 showed promise of immense development. An estimated $34,000,000 was spent for geophysical work on the U. S. side of the Basin in 1952. During that year, operators drilled 240,035 feet of wildcat wells at a cost of more than $2,500,000 in South Dakota.

Standard Oil of Indiana, recognizing the potentialities of Williston Basin, will begin construction next May of a 30,000 barrel-per-day refinery. The

THE DU PONT DIGEST

A GROWING FIELD—

Instrumentation

Modern manufacturing trends at Du Pont bring ever-increasing opportunities for technical men

Do you think of instrumentation as applying only to work in electricity and electronics?

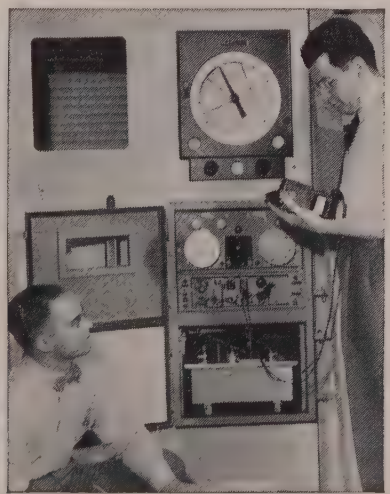
Or would you also include problems in chemical processing, materials of construction and materials handling, as well as application of equipment — both mechanical and hydraulic—for measurement and control systems?

At Du Pont, instrumentation is applied to widely diverse areas of manufacturing operations. It calls for many different technical backgrounds. In a typical instrument group there may be men whose formal training has been in mechanical, chemical, electrical or metallurgical engineering, or in physics, etc.

Instrumentation is becoming more and more important in the chemical industry. In fact, many of today's processes and products would not be possible without modern measurement and control systems. The trend toward continuous processes means challenging and constantly increasing opportunities for instrumentation men.

Du Pont's instrument program includes research, development, design, and supervising installation of process control equipment. Some of the work is done in the central Engineering Department at Wilmington. However, most of the major plants across the country now have their own organized instrument groups.

Fred R. Struder, *B. Metal W., Rensselaer P.I. '50, examines a pressure strain recorder with Allen R. Furbeck, E.E., Princeton '39.*



Richard G. Jackson, *B.S. in Ch.E., Columbia '42, and Gregory L. Laserson, Ph.D. in M.E., Columbia '49, test an infrared gas analyzer.*

Paul D. Kohl *(left), B.S. in M.E., Purdue '46, checks the assembly of an experimental control instrument.*

So you may visualize the scope and diversity of the work, here are examples of instrumentation recently developed and designed by Du Pont technical men:

1. A device to measure flow of approximately 30,000 lbs. per hour of gas at more than 10,000 p.s.i. To give 1.2% accuracy and be responsive to flow-changes of five cycles per second.

2. A device to monitor continuously 1200 similar temperatures. Equipment to record temperature and sound alarm at a deviation of 1°C. from desired point.

3. An automatic control system to maintain a predetermined pressure-temperature relation in a large-batch autoclave during spontaneous reaction between two chemicals.

Thus it can be seen that Du Pont instrumentation is limited to no single avenue of engineering. Men with an aptitude for the work get experience in many phases of the Company's technical activities—and an excellent background for positions in management and administration.

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BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Watch "Cavalcade of America," on Television

works is to be located about three-quarters of a mile north of Mandan, North Dakota on a 900 acre site. Principal products to be manufactured there are gasoline, kerosene, heater oil, diesel fuel, furnace oil, power fuel, and industrial fuel oil. Products will be shipped from the refinery by rail, truck, and thru a products pipeline to Moorhead, Minnesota. At Moorhead a connection will be made with Standard's northwest products pipeline originating at Whiting, Indiana.

When completed by 1955, the refinery will include modern equipment for crude oil distillation, catalytic cracking, polymerization, vapor recovery, finishing, and shipping.

As I said before, this discovery presents tremendous opportunities to us, for here is an entirely new technical area still in its formative stages. Williston Basin is a pretty display as it grows today, because it will need engineers, all kinds of them; chemists, to do old jobs and research in new fields involving petro-chemical techniques; businessmen and executives to administer operations; and thousands to keep the economy going.

I SPEAK MY PIECE

by Walter G. Olesky, L.A.S., Pre-Journalism

You engineers! You inventors! Have you ever stopped to think of the problems, of the social consequences evolved from your *brain children?* Right now one of your progeny — namely *TV* — is being condemned daily. This robot, this monster has become the whipping boy, the alibi, the excuse and, at once, the cause of many of our personal, local and public ills — homework . . . housework . . . chores . . . bedtime . . . juvenile delinquency and crime . . . Just watch the papers! As an "embryo" journalist, may I contribute my piece?

How is television influencing the youth of America? What are the social consequences of television? The answer is relatively simple.

One growing problem, however, is television's time-consumption without sufficient educational reward. You may argue that this is problematical only to the indiscriminate viewer.

Television has made constant advancement in its effort to supplement routine entertainment programming with educational fare. With the birth of television channels devoted entirely to education, educational programming seems even closer to becoming a reality.

Meanwhile, worthwhile selection is the responsibility of every person old enough to choose his TV entertainment discriminately; it is also the responsibility of parents to control the selection of TV shows for children.

There are scores of worthwhile TV shows regularly that are interesting and instructive, concerned directly and incidentally with the broad task of education. The viewer can sprinkle his diet of murder, pathos, comedy, and dry-gulching with a nightly side-dish of educational TV if he wishes.

It is difficult to see the scandalous implication of a major Chicago newspaper's survey of Christmas shows for children, which counted an appalling number of murders offered to child viewers. Couldn't that survey be taken at any time during the year with resultant figures of murders, lynchings, fistfights, and suicides? If parents are appalled as such news, they should be interested enough to take a hand in the selection of programs which their children view, and insist upon a well-balanced diet of television viewing, both constructive and entertaining.

For me there's nothing wrong in watching my favorite blood-and-thunder dramas on television. We college oldsters who can remember radio used to listen to the same old blood-and-thunder blueprint stories (and a lot of us imagined the gory murders a lot better than they show us on TV); so far no one has attributed my retarded mentality to poor old radio.

The curse of television is in the lazy fellow it makes me. Naturally I'm justified in getting my first few months' worth out of TV. But that's the dangerous time. That's the time during which my habits are formed. That's the best time to decide what my TV future will be—chained to it? — Can father watch the good shows, and become too relaxed to turn it off when the dull shows come on? Is he going to forget his hobbies of building or repairing things, or reading a book about something he always wanted to know?

Can mother keep up with "Guiding Light" and "Hawkins Falls, pop. 6,200" and her baking, mending, and ironing at the same time? Does mother turn TV into her baby sitter?

What of the children? Television is taking away the play habits of children. Outdoor games are being discarded in favor of parlor watching. Summer streets are too often barren of roller skaters, marble-players, hop-scotchers, winter streets too often barren of belly floppers and snow-ball fighters. Parlor pallor and lethargy stalk the house.

Television is a thief, walking boldly into living-rooms, stealing imagination, vitality and time. If we don't defend ourselves by discriminate viewing, we might as well get out the popcorn and padded pillows and call it a day.

In the event that you're asking yourself: "What IS worthwhile on TV?", here are a few suggested shows. All of the following shows cannot be good, but they are an effort on the part of TV program directors to satisfy the "thinking" mind as far as sponsors will allow.

From a private survey, Sunday is the day with the most educational TV shows. Now remember that the man said about quantity and quality, and find the shows you like best.

At noon, Sunday, WNBQ offers "Youth Wants To Know", with distinguished political and educational guests.

"How Does Your Garden Grow," with John Ott, discussing horticultural developments, such as "Growing Plants Under Fluorescent Light", WNBQ, 1 p. m.

"American Forum of the Air", discussion of political issues, WNBQ, 1:30 p. m.

"Omnibus" (Ford Foundation Workshop) takes you into the realm of world-interest, from Shakespeare to Lincoln, old movies of the Wright Brothers' early flights, and new movies of helicopters in war, etc., WNBQ, 3:30 -5 p.m.

"Meet the Press", interviews with notables, WNBQ, 5 p.m.

Edward R. Murrow's "See It Now" (taking you inside USA and around-the-world), WBKB, 5:30 p.m.

"Press Conference", panel interviews, WGN-TV, 6:30 p.m.

"Victory At Sea", film series, story of sea power during World War II, WNBQ, 9:30 p.m.

Monday begins a five-day TV trip to Chicagoland colleges with "Illinois

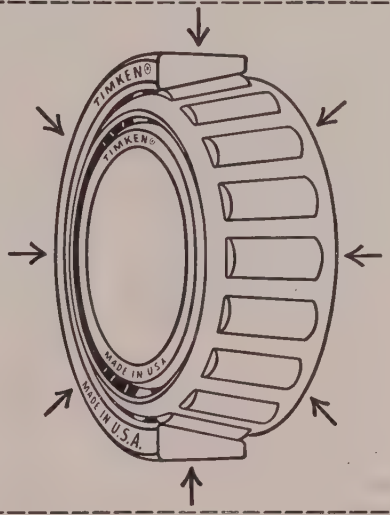
Another page for **YOUR BEARING NOTEBOOK**

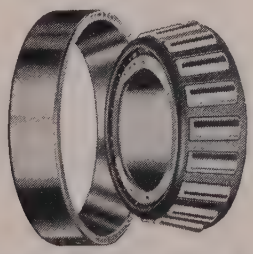
Largest two-crawler shovel keeps going on TIMKEN® bearings

Designed to meet the trend toward larger excavating and hauling units, Marion Power Shovel Co., built a new 10-cubic yard 191-M shovel with a production potential of over 600,000 yards a month. To keep it on the job every day of the month with minimum maintenance, Marion engineers equipped it with Timken® tapered roller bearings at all vital points. Timken bearings carry radial and thrust loads in any combination. Their true rolling motion and smooth finish practically eliminate friction. By keeping housing and shaft concentric, they make closures more effective. Lubrication time and costs are cut.

All loads are the same to a TIMKEN bearing

The tapered design of cup, cone and rollers of Timken bearings enables them to take radial loads, thrust loads, or any combination of the two from any direction. Timken bearings do away with the need for auxiliary thrust bearings or plates. They simplify design, cut costs, save space.





TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Want to learn more about bearings?

Some of the engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'll be glad to help. For a copy of the 270-page General Information Manual on Timken Bearings, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ⓪ AND THRUST →⓪← LOADS OR ANY COMBINATION ✳

Tech", WBKB, 2:30 p.m.

"Johns Hopkins Science Review", WGN-TV, 7:30 p.m.

"Dr. Fixum", for the household genius, WENR-TV, 10:30 p.m.

Tuesday continues the educational series from "Lake Forest College", WBKB, 2:30 p.m.

"Life Is Worth Living", the best of the general education shows on TV, deserves special consideration from viewers because its star, Bishop Fulton J. Sheen, credits viewers with having enough mental power to follow him through non-political, non-sectarian, but Christian education. WGN-TV, 7 p.m.

"What's the Great Idea", WBKB, 7 p.m., brings demonstrations of new inventions to the TV audience.

"Wisdom of the Ages", WGN-TV, 8:30 p.m. speaks for itself.

Wednesday's only offer is "Loyola University", WBKB, 2:30 p. m.

Thursday's only offer is "University of Illinois", WBKB, 2:30 p.m.

Friday, "Roosevelt College", WBKB 2:30 p.m.

"Walt's Workshop", a popular long-run TV show with Walter Durbahn, instructs viewers in wood craft, WNBQ, 7:30 p.m.

"The World Is Yours", travel show, whets the appetite by movies of places like the Indies, Rio, New Orleans, etc., done in good style with smooth lectures and appropriate background music. WGN-TV, 8:30 p.m.

Saturday is represented by "Farm and Home Time", WBKB, 12 noon.

"Jet Pilot" brings the intricacies of aviation down to laymen's terms, WNBQ, 5:30 p.m.

(We hesitate to add "Mr. Wizard", but for the kiddies, Don Herbert masters the magic of science; WNBQ, 6 p.m.)

"Farm Town, U.S.A.", WBKB, 8:30 p.m. rounds out Saturday's fare, and completes a week's educational television offerings.

Try some of those on your TV dial, and if you don't like any of them, then take out the popcorn and padded pillows, and save a seat for me.

The Gullible Public and TV

by Ronald Swallow, E. Physics '56

The quality of many TV sets is sharply declining. In recent years because of strict competition and public demand for a "cheaper" set, manufacturers have been forced to "cut", that is, reduce the number of parts. As a result, the parts are overworked, and tube and circuit failures are twice as frequent as they were only a few years back.

During the first years of the TV industry, a set was a masterpiece of scientific know-how. A set was designed to perform for years without trouble. Not only were its electrical circuits designed under mathematical calculations, but little room was left for improvement on design. The tubes performed their functions well within their range of safe operation. No expense was spared to give the best, clearest and sharpest picture on the screen.

The pioneers in the manufacturing of TV sets had little competition during the first year. Their sets were, of course expensive; but they were good sets. One by one their former competition in radio switched to the TV industry, and before long the market was full of different makes and models. Each manufacturer produced a set slightly cheaper than his competitors and did so by leaving out one or two parts without apparently affecting their function. This cutting has been going on for years and the result is beginning to show up on the operation of the set.

A manufacturer can "cut" on the number of parts in his set in various ways. He may redesign several circuits by letting one tube do the work of two. This is the most common way of reducing the price of a set although the function of the set is not affected to any noticeable extent. After a year has passed, however, the trouble begins. Not only do the overworked tubes go out one by one, but most of the parts in the circuit have shifted in their respective values causing the set to be "sensitive" to operate. The picture becomes wavy and unstable. This trouble could have been prevented by an Automatic Gain Control circuit which strengthens the impulse signals that hold the picture stiff and straight. The circuit, however, is usually left out because the wavy condition does not start causing trouble till the manufacturer is free of financial or guarantee relations with his customer. Consequently, unless the maker has unusual pride in his product, he does not seem to have obligation to account for and to correct this difficulty.

Tube cutting is first started in the low-voltage supply circuit. In the well-designed sets two power tubes are required to change the AC voltage from the low-voltage transformer to DC. Instead, one tube is used. Lately, selenium rectifiers are being used — not only to replace the remaining tube — but to eliminate the $15.00 low voltage transformer. However, the filaments of all the tubes that had previously received their voltage from the low voltage transformer, consequently had to be hooked up in series across the 110 AC line. Under such conditions the tubes too often have a tendency to burn out. In addition, the selenium rectifiers in many sets fail within a couple of years, giving the owner a fairly high repair bill; had the transformer been used with a rectifying tube, it would have cost him perhaps half as much.

Another common area for tube cutting is in the high-voltage circuit. Where two expensive, more durable tubes had been used, one less expensive and less durable is transplanted. One of the most common tube failures in a TV set is this tube. By making this change in the circuit, the manufacturer is able to save opproximately $10.00 in the selling price of his set. In the long run, the owner pays $25.00 in repairs.

A third area of cutting is in the amplifying stages where the weak signal, picked up by the antenna, is greatly amplified or strengthened to the point where it is able to give a clear and sharp picture on the screen. In this case several tubes are left out, reducing the overall amplification of that particular stage. Less signal means less picture detail. However, to the average buyer a new TV set picture looks just like any other and only the price seems to affect him.

The remaining tubes in the amplifying stage are usually overloaded in order to assure their proper function. If one tube weakens and the overload is not able to make up for its drop in emission, the whole stage is not able to function until the tube is replaced. Previously the

A MESSAGE TO COLLEGE ENGINEERING STUDENTS

from A. C. Monteith, Vice President in Charge of Engineering and Research, Westinghouse Electric Corporation

There's room to grow at Westinghouse

It's natural that you sometimes wonder about the "elbow room" in the field of engineering. Even though the past half century has witnessed great technological developments, they are only a prelude to the things to come. We have barely scratched the surface in the fields of engineering development and research. And that, most certainly for you, should mean there *is* room to grow.

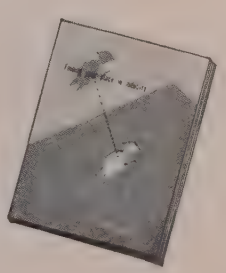
But first you must find the right starting point—a company which will give you the opportunity you want in your career. Westinghouse offers you this kind of opportunity, for it is a growing company in a dynamic field. Energy is our business. Here at Westinghouse, well planned orientation and training, continued education, position rotation, and management development are all offered to provide you a favorable climate in which to grow.

To those who are prepared and willing—whether inclined toward research, engineering, manufacturing or sales—opportunities with Westinghouse are limitless.

G-10252

For information on career opportunities at Westinghouse, consult Placement Officer of your University, or, send for our 34-page book, *Finding Your Place in Industry.*

Write:
Mr. L. J. Dunlap
District Educational Co-ordinator
Westinghouse Electric Corporation
Merchandise Mart Plaza
Chicago 54, Illinois



YOU CAN BE SURE... IF IT'S

Westinghouse

tubes in well-designed sets were able to drop off in emission to the point where they were nearly dead, and still function satisfactorily.

The lack of "real life" detail pictures on all TV sets is not the fault of the manufacturers. The detail of the picture is determined by the number of horizontal lines across the screen. Originally experimental TV sets were designed with twice the number of lines across the screen and therefore twice the detail. The FCC (the Federal Communications Commission) set up a standard by which there would be less picture detail. The reason for this is that the picture detail or the number of lines across the screen is directly proportional to the band width of high radio frequencies required for each TV channel. In order to have twice the detail that we have today, manufacturers and transmitting stations would find it necessary to use a band width of 9 megacycles rather than the present 4.5. This would reduce the number of channels by half. Since 4.5 megacycles give us 13 channels, 9 would permit only 6. However, it will not be long before the UHF (Ultra High Frequency) stations start broadcasting. They will permit the opening of 40 more channels; thereby the FCC can double the picture detail on TV sets. At present this is only a possibility.

We cannot accuse the manufacturers of complete guilt in this let-down in the quality of today's average TV set. Manufacturers are responsible, however, for an educational program (via advertising) whereby the non-scientific-minded public can learn to discriminate by knowledge as well as by price. Only by such ethical procedure can scientists protect their inventions and give to Americans the best that electronics can offer.

A first grade teacher fresh from college was taking over class for the first time. Upon entering the class she noticed a nasty word on the blackboard. (Signed only by the Phantom). She didn't know what to think or do. So she said, "Now children let's fold our little hands, put them on our little desks, and put our little heads down on the desk. Then the person who wrote this word on the blackboard will come up and erase it." So they all folded their little hands, and put their little heads on their desks. All was quiet for a short spell, then there was a thump, thump, thump, thump of little feet, a pause, and a thump, thump, thump of little feet going back to the desk. After everything was quiet again the teacher said, "Now let's see if the word has been thoroughly erased." So they all looked to the board. Much to their surprise they found written there, a nastier word, and "The Phantom strikes again."

"We Take What We Can Get"

by Wallace Snyder and Robert Schultz, E.E. '56

The personnel manager of a company which annually hires hundreds of engineering graduates recently stated, "We take what we can get." Today, where trained manpower is concerned, industry can not afford to be proud. The fact that industry is suffering from a lack of trained engineers and scientists is universally realized. Industry needs 30,000 new engineers every year for normal replacement and growth. In 1951, there was a shortage of 60,000 engineers. This condition is expected to continue for several years.

Due to industry's ever-increasing demands, and this present shortage of engineers, our chances for a job after graduation are practically assured. Even the man at the bottom of the class, in most cases, find an excellent position. Our future looks bright if we're concerned only with getting and holding a job.

However, most of us feel that merely getting a job and receiving a check every week is not sufficient. We want to "go somewhere" in the engineering field. We want promotions, salary increases, or even an occasional pat on the back. We want to climb—not plod along in a rut.

The obvious questions at this point is: What qualifications are necessary to achieve a reasonable amount of success as an engineer? To answer this it is necessary to know what industry expects of the new engineer.

Technical ability is an indispensible quality. It is the basis on which most engineers are hired and, in later years, it will prove to be one of the determining factors toward advancement. It is usually the man with the well-rounded background in physics, mathematics, and engineering principles who advances quickest. Narrow specialization in a particular field of engineering is not recommended by industry since the versatility of the new engineer is too limited. Industry desires men whose technical background provides a firm foundation for a technical ability which increases with the passing of time. Perhaps this accounts for on-the-job training programs in many of the larger companies.

The ability to write, read, and speak effectively is deemed valuable in engineering as well as in other fields. Since the engineer works with people in addition to objects, he must be able to express himself clearly and accurately at all times. Ideas without the ability to communicate are not of much use. As a result, most industrial personnel men feel that English and literature courses are just as important as math courses.

The knack of understanding and being able to work with people is necessary to the engineer. For this reason industry beams on such college courses as philosophy, psychology, and similar humanistic-social programs. The antagonistic engineer has no place in industry, regardless of his technical ability, unless he plans to isolate himself in the dark corner of a remote laboratory. Obviously the qualities of co-operation and understanding cannot be fully gained from textbooks and lecturers. Extra-curricular and social activities help to convert classroom facts into working knowledge.

If the engineer is going to gain promotion and leadership, he must be willing and able to assume responsibility. Otherwise, he will find that he stays at his job while engineers with less seniority move to higher positions. Responsibility every potential engineer can practice in his college years. Extra-curricular activities and sports by themselves will not guarantee success, but they can give the student co-operative and leadership opportunities.

Leadership and organizational abilities are recognized essentials to a brilliant career in any field. These characteristics are high on the list of traits required of men who are selected for management in industry. Since 40% of management is recruited from the ranks of engineers, can we afford to lose a chance or a moment to develop these cited qualities?

So, in these days when industry's motto is "We take what we can get," we potential engineers are virtually assured of jobs. Getting the job? Where will we be at 35? at 45? What ruts lie in wait for us? The "side" learning and experience in leadership, cooperation and organization can make or break the most skilled technician in engineering.

The preceding article is the result of conferences with personnel men at the Chicago offices of Bell Telephone and Hallicrafters Radio Corporation. Our reading deals with General Electric policies as well as those of Allis-Chalmers, Dupont and the Studebaker Corporation.

Richard J. Conway, Lehigh '51, selects Manufacturing Engineering at Worthington

RICHARD CONWAY checks cutting tool with machinist before milling a pump casing.

After completing his general training which brought him in contact with all departments, Richard J. Conway decided that manufacturing engineering was his field. He says, "I chose the Manufacturing Engineering Department after completing my general training at Worthington because as a graduate in Industrial Engineering I can learn the practical aspects of my field while applying theory I learned in college.

"The personnel of this department work together as a team toward the solution of the numerous problems which arise daily. We have the cooperation of all other departments in the corporation in getting the necessary facts pertinent to the solution of these problems. In the course of our day it may be necessary for us to meet the Plant Manager, Chief Engineer, Comptroller, several department heads, clerks, foremen, machinists and many others throughout the company.

"I have contributed to the solution of many problems handled by this department including metal spraying, machining procedures, purchasing new equipment and designating proper dimensions to obtain desired fits between mating parts.

"I enjoy my work because I'm doing the work I want and my formal education is being supplemented with practical knowledge gained from the tremendous wealth of knowledge available to me at Worthington. I know from personal contact with many other departments in the Corporation that Worthington can and will find their young engineers a spot which will give them the same opportunities as have been afforded me."

When you're thinking of a good job, think *high*—think *Worthington.*

FOR ADDITIONAL INFORMATION, see your College Placement Bureau or write to the Personnel and Training Department, Worthington Corporation, Harrison, N. J.

WORTHINGTON

The Sign of Value Around the World

An open letter to the College of Engineering:

Once again we have successfully put on another Engineering Open House. Thanks to your efforts, the Open House was a real success which will lead to bigger and better Open Houses in the future.

Hundreds of people spent many hours working on the Open House this year. And now the natural question arises, "What has been accomplished by all this effort?" The answer to this question are many.

High school students have received a glimpse of what engineering is, and can better choose their future careers. The rest of the campus has been shown what a potent force the College of Engineering is in the educational system of the University of Illinois.

The general public has seen the vast potential of engineering.

Above all, you, the students and faculty of the College of Engineering, have worked together to produce an exposition of which any University in the country could be proud. So long as this can be done, engineering will remain a living, vital force at the University of Illinois.

Sincerely,

Bob Schrader,
General Chairman,
1953 Engineering Open House

to the

ELECTRICAL ENGINEER

or

PHYSICIST

with an interest in

RADAR

or

ELECTRONICS

Hughes Research and Development Laboratories, one of the nation's leading electronics organizations, are now creating a number of new openings in an important phase of their operation.

Here is what one of these positions offers you:

THE COMPANY

Hughes Research and Development Laboratories, located in Southern California, are presently engaged in the development and production of advanced radar systems, electronic computers and guided missiles.

THE NEW OPENINGS

The positions are for men who will serve as technical advisors to government agencies and companies purchasing Hughes equipment—also as technical consultants with engineers of other companies working on associated equipment. Your specific job would be essentially to help insure successful operation of Hughes equipment in the field.

THE TRAINING

On joining our organization, you will work in the Laboratories for several months to become thoroughly familiar with the equipment which you will later help users to understand and properly employ. If you have already had radar or electronics experience, you will find this knowledge helpful in your new work with us.

WHERE YOU WORK

After your period of training—at full pay—you may (1) remain with the Laboratories in Southern California in an instructive or administrative capacity, (2) become the Hughes representative at a company where our equipment is being installed, or (3) be the Hughes representative at a military base in this country—or overseas (single men only). Compensation is made for traveling and moving household effects, and married men keep their families with them at all times.

YOUR FUTURE

In one of these positions you will gain all-around experience that will increase your value to our organization as it further expands in the field of electronics. The next few years are certain to see large-scale commercial employment of electronic systems. Your training in and familiarity with the most advanced electronic techniques now will qualify you for even more important future positions.

How to apply:

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Scientific and Engineering Staff
Culver City, Los Angeles County, California

See your Placement Office for appointment with members of our Engineering Staff who will visit your campus. Or address your resumé to the Laboratories.

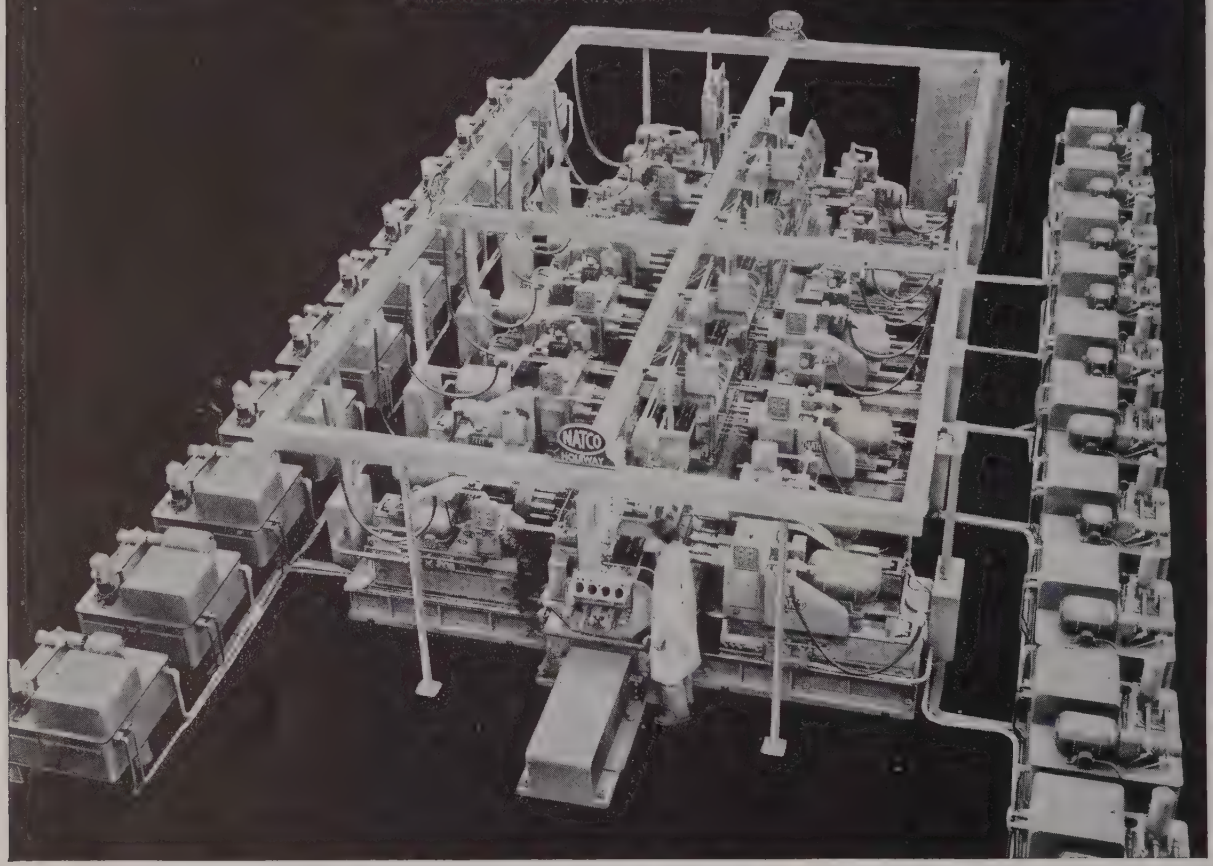
Festival of Contemporary Arts

Above: The plan of Chicago as submitted by architects from the Chicago Institute of Architects working with the University. Below: Control room at the University television station. Right: Cameraman demonstrating operation of a television camera.

Above: University of Illinois television studio and control room, east side of the stadium in the East Great Hall. Below: Demonstration of operations inside the control room. Left: Modern Dance techniques at the Festival of Contemporary Arts.

Photos by Armand Andre
Met. '56
Technograph Staff
Photographer

COULD YOU *ENGINEER* THIS MACHINE?



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NATCO is a recognized leader in the machine tool field, having passed a half century of loyal service to industry.

Each NATCO machine is individually engineered to our customers' exacting requirements. Development, design, sales and industrial engineers are needed to help carry on this exacting work.

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National Automatic Tool Company, Inc.
RICHMOND, INDIANA

NATCO

IT'S A YOUNG MAN'S *Aviation* WORLD

McDONNELL *Aircraft*

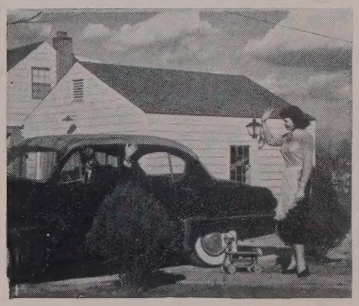
IT'S A YOUNG MAN'S COMPANY

THIS IS NOT A "STATIC WORLD"

The aircraft world is a rapidly changing, competitive one. In it, youth is an asset, for it requires a young flexible mind to visualize the practicality of today's research data and evolve from it the aircraft of tomorrow. It is this type of vision that has characterized the achievements of the McDonnell engineering team—a team that places the accent on youth. The average age of M.A.C.'s engineering staff is thirty years.

WHAT CAN YOU DO?

You can, as many other graduates from your school have, become a M.A.C. Engineer. We offer you not just a job, but a full-fledged engineering assignment that will challenge your creative ability. There are a variety of positions available in our Airplane, Helicopter, and Missile Divisions for Engineering, Mathematics, and Physics graduates.



You can live in beautiful suburban St. Louis and still be near the McDonnell plant at Lambert Field, 11 miles from the city. Enjoy the comforts of "county" living, with easy access to "big city" shopping, entertainment, medical, and educational facilities. Our Housing Representative will assist you.

Build Your Future With A Company . . . Young In Years, Young In Spirit And Ideas

For more information about our company and our community, see your Placement Officer. Ask about the McDonnell Graduate Study Plan and our engineering booklet "Your Future Has Wings."

LAWRENCE A. WEEKS

Chief—Stress Engineering—Airplanes
(B.S.C.E.—Iowa State College—'43)
(M.S. Applied Mechanics
Washington U., St. Louis—'50)

Larry will soon receive his ten-year service pin as a M.A.C. engineer. His present responsibilities would be a burden for a man twice his age. At 31, Larry supervises a large group of engineers in the structural design of all M.A.C. airplanes.

CALVIN J. BLATTNER

Design Engineer—Missiles
(B.S.A.E.—Notre Dame U.—'46)
(M.S. Applied Mechanics
Washington U., St. Louis—'52)

Cal started his career with M.A.C. in September 1946. He now supervises an engineering group concerned with dynamics analysis of fire control systems. Although only 27, he has found time to earn his Master's Degree in Applied Mechanics.

PAUL T. HOMSHER

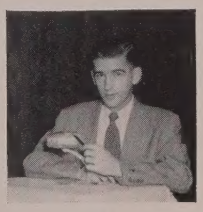
Project Flight Test Engineer—Airplanes
(B.S.A.E.—Purdue—'45)

Paul has been a member of our Airplane Engineering staff since April 1947. He is now Project Flight Test Engineer on the F3H Demon airplane. In this position he supervises several other engineers programing and analyzing flight test data. Paul is 30 years old.

ROBERT W. FALCONER

Design Engineer—Helicopters
(B.S.A.E.—Univ. of Illinois—'48)

Bob, who recently celebrated his 28th birthday, joined the McDonnell team in August 1948 as an Assistant Research Engineer. Presently, he is in charge of the jet engine design for helicopters.



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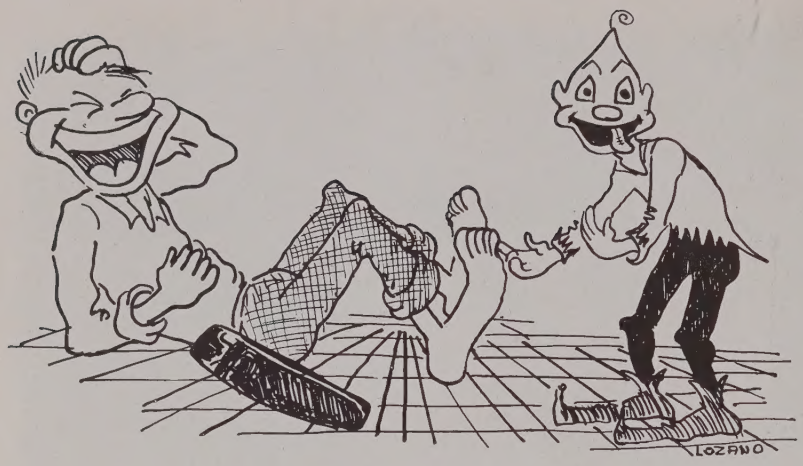


TECHNOCRACKS

edited by Phyllis Krone and Freddi Wallk

A man was perched atop of one of Atlanta's highest buildings, contemplating suicide, and a policeman had made his way to the roof to try and persuade the man not to jump. "Think of your mother and father," pleaded the officer.

"Haven't any."

"Think of your wife and children."

"Haven't any."

"Well, think of what your girl friend might think."

"I hate women."

"All right, think of Robert E. Lee."

"Who's he?"

"Go ahead and jump, you damn Yankee!"

* * *

For the first time in her life little Nellie watched a cat carrying her kitten by the nape of the neck.

"Shame on you," cried the youngster. "You ain't fit to be a mother. You ain't even hardly fit to be a father!"

* * *

An after dinner speaker had gone on and on for what seemed several hours. Finally, one member of the audience slipped away from the table and out into the hall. There he met a fellow banqueter who had slipped out earlier.

"Has he finished yet?" he asked.

"Yes," replied the one who had just come out, "a long time ago, but he won't stop."

* * *

Little Patricia was watching her mother apply cold cream to her face, and asked, "What's that for, Mommie?"

Mother answered, "Why, this is to make me beautiful."

After the cold cream had been removed with tissues, Patricia sadly remarked, "Didn't work, did it?"

A feminine tourist pointed to a decorated skull in a show case: "Do you know whose skull it was?"

Tired Mexican Guide: "That is the skull of the Emperor Montezuma."

The Giddy One then pointed to a smaller skull in the same case: "Who was that?"

Guide (with perfectly straight face): "That, Madam, is the skull of Montezuma when he was a little boy."

* * *

Overheard on the bus: "Well, if her husband is a self-made man, he certainly hired awfully cheap labor."

* * *

Speaking on the dangers of modern food, the speaker pointed a finger at a harassed looking listener and demanded, "What is it that we all eat at some time or another, that is the worst thing imaginable for us? Do you know, sir?"

Softly came the answer from the little man, "Wedding cake."

* * *

It has developed that a true friend is one who visits you when your television is on the blink.

* * *

In many small garages the service men identify cars by the names of their owners. When repairs are needed, or special services required — other than storage—this practice leads to some interesting notes in the day book of orders. To-Wit:

Mrs. Ellis won't start.

Give Miss Jackson some alcohol. Two quarts ought to hold her.

Something wrong with old man Pitt's wiring.

Mrs. Wendham's fenders bumped. Not responsible.

Wash Miss Jenkins.

Luck is what happens when preparation meets opportunity.

* * *

There is a close relationship between hard work, a light heart and a clear mind.

* * *

No one grows old by living — only by losing interest in living.

* * *

Mockery is the weapon of those who have no other.

* * *

A great deal of water can be gotten from a small pipe, if the bucket is always there to catch it.

—*National Safety News*

* * *

When a man is in earnest and knows what he is about, his work is half done.

* * *

Doctor: You're the father of triplets.

Politician: Impossible! I demand a recount.

* * *

Ted: How did you break your leg?

Ed: I threw a cigarette in a manhole and stamped on it.

* * *

Woman: Are you the man who gave my son a dog?

Man: Yes, I am.

Woman: Well, you'd better come over and take them all back.

* * *

A certain businessman had the habit of leaving his umbrella at his office. One morning as he was going to work he sat next a young lady in the trolley car, and as he rose to get off he absentmindedly picked up her umbrella.

"Pardon me," she said, "but this is mine." The man was quite embarrassed, naturally.

That night he decided to take all his umbrellas home with him from the office.

When he got in the trolly car, there sat the same young lady. She leaned forward and said in a low tone:

"I see you did pretty well today after all."

* * *

Remember that old woman who saved her wedding dress for her daughter? Now she has a daughter who saves her wedding dress for her next wedding.

* * *

"It says here in the paper that in New York a man is run over every half hour."

"My! my! Poor fellow!"

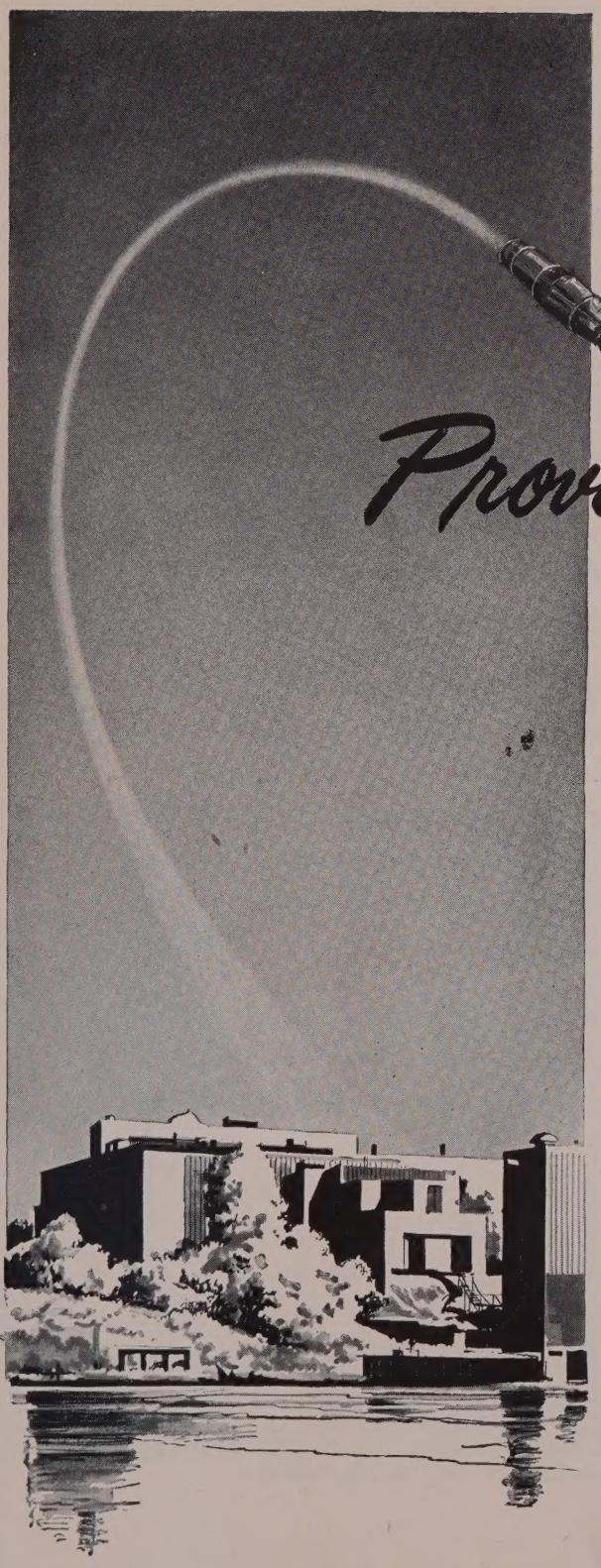
* * *

Teacher: How old would a person be who was born in 1920?

Smart Kid: Man or woman?

* * *

When you buy things for a song, watch out for the accompaniment.



Proving Ground

FOR WASPS

There's no easy way to create a new aircraft engine. *Better designs* for the famous Wasp engines come only after long research — an endless quest for perfection.

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DIVISION OF UNITED AIRCRAFT CORPORATION

EAST HARTFORD 8, CONNECTICUT U.S.A.

March 15, 1953

Gettysburg Address . . .

(Reprint from the Arizona Tax Research Association)

One score and sixteen years ago our fathers brought forth upon this nation a new tax, conceived in desperation and dedicated to the proposition that all men are fair game. Now we are engaged in a great mass of calculations, testing whether that taxpayer or any taxpayer so confused and so impoverished can long endure.

We are met on Form 1040. We have come to dedicate a large portion of our income to a final resting place with those men who here spend their lives that they may spend our money. It is altogether anguish and torture that we do this. But in a large sense, we cannot evade, we cannot cheat, we cannot underestimate this tax. The collectors, clever and sly, who computed here, have gone far beyond our own poor power to add and subtract.

Our creditors will little note nor long remember what we pay here, but the Bureau of Internal Revenue can never forget what we report here. It is for us, the taxpayer, rather to be devoted to the tax return which the government has thus far so nobly spent. It is rather for us to be here dedicated to the great task remaining before us—that from these vanishing dollars we take increased devotion to the few remaining; that we highly resolve that next year will not find us in the higher income bracket; that this taxpayer, underpaid, shall figure out more deductions; and that the tax of the people, by the Congress, for the Government, shall not cause solvency to perish.

By the Grace of All That Seems Eternal and Unholy—Amen.